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BOUNDED RATIONALITY
IN THE EMERGENCY DEPARTMENT

A dissertation submitted in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

by

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Dipl.-Ing. (FH), Hochschule der Medien, 2003

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2009
Wright State University

WRIGHT STATE UNIVERSITY
SCHOOL OF GRADUATE STUDIES

June 26, 2009

I HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER MY SUPERVISION BY Markus Alexander Feufel ENTITLED Bounded Rationality in the Emergency Department BE ACCEPTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF Doctor of Philosophy.

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ABSTRACT

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This research aimed at understanding bounded rationality – that is, how simple heuristics result in satisfactory outcomes – in a naturalistic setting where agents have to meet environmental demands with limited resources. To do so, two methodological approaches were taken, an observational and an experimental study of U.S. emergency physicians who have to provide a satisfactory level of care while simultaneously coping with uncertainty, time and resources constraints. There are three major findings. First, based on observations of 12 resident and 6 attending physicians at two Midwestern emergency departments (ED), ED physicians use at least two general heuristics. One heuristic exploits symptom-disease relationships with the goal to rule out ‘*worst cases*’ that would require immediate medical attention. The other heuristic aims at identifying diseases that are *commonly* associated with a set of symptoms. Thus, whereas the former heuristic emphasizes medical safety by aiming at identifying even unlikely ‘worst cases,’ the latter stresses efficiency by aiming at separating typical worst from common benign cases to allocate resources appropriately. Second, the selection of general heuristics is situated in an environmental context. This context is reflected in *epidemiological constraints* that delimit the range of patients’ potential medical problems as well as *sociocultural constraints* that delimit the range of potential, desirable, or required care solutions. ED physicians’ exploit these constraints to actively (re)formulate the problem to-be-solved and select strategies that satisfy requirements for safe and efficient care. Third, based on

observations and data from 39 clinicians-in-training who participated in the experimental study, emergency care delivery is the solution of medical problems in a *socially dynamic setting*. ED physicians aim at understanding their patients' needs and circumstances to obtain salient information about potential (medical) problems and, ultimately, adapt the selection of general heuristics to a particular situation/patient. Thus, a caring attitude and safe and effective emergency care are not contradictory but dynamically intertwined. The descriptive-exploratory methodology chosen does *not* allow conclusive statements. However, findings point to promising avenues for future research such as the impact of sociocultural constraints on the selection of safe and efficient care strategies or the clinical relevance of the social connection between patient and physician.

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INTRODUCTION

Early accounts of human decision making – for example, the concept of the ‘homo economicus,’ which can be traced back to John Stuart Mills’ work on political economy (Persky, 1995) – adhered to the idea of a perfectly rational decision maker who aims for the maximization of expected utility and minimization of expected loss. As a reaction to this unachievable ideal Herbert Simon (1955, 1956) introduced the notion of *bounded rationality* as a psychologically more realistic account of human behavior. This concept states that purposeful behavior is, on one hand, bound by limits of cognitive capacities such as knowledge, memory, and attention (Simon, 1955). On the other hand, functional achievement is bound by properties and constraints of the actor’s environment as well as the relationship between cognitive strategies and environmental structure (Simon, 1956; 1990). In a given environment, boundedly rational people, Simon contends, “adapt well enough to ‘satisfice’; they do not, in general, ‘optimize’” their choices and behavior (Simon, 1956, p. 129). Based on the assumption of humans as satisficers under constraints, the present research investigated bounded rationality from two perspectives. These perspectives are complementary in that they investigate the cognitive processes underlying boundedly rational behavior with respect to particular environmental contexts. However, they have been conceptually largely unrelated (see Bryant, 2002; Todd & Gigerenzer, 2001).

The first perspective, labeled *ecological rationality*, is mainly concerned with establishing detailed models that explain and prescribe formally the extent to which certain decision strategies are able to capitalize on the statistical, physical and social

structures of a particular environment (Gigerenzer, Todd, & The ABC Research Group, 1999; Smith, 2003). This approach to studying bounded rationality has demonstrated convincingly via experiments and simulations that fast and frugal heuristics do not only respect peoples' cognitive bounds (they are computationally manageable) but yield desirable outcomes (they are ecologically rational) if they are able to exploit information that is predictive or salient in a particular environment (e.g., Gigerenzer et al., 1999). In other words, ecologically rational agents somehow identify functionally salient information structures in their environment and select computationally manageable strategies, which capitalize on these structures. Hitherto, research into ecologically rational decision making has provided only scarce empirical evidence as to how people accomplish this task in complex, real-world settings. More fundamentally, a recent programmatic review of the ecological rationality paradigm concedes that "Exactly how people are able to determine which type of [information] environment they are in, and then which heuristics will be appropriate to apply, remains an open question" (Todd & Gigerenzer, 2007, p. 169).

The second perspective aims at capturing human rationality in real-world settings (e.g., Klein, Orasanu, Calderwood, & Zsombok, 1993; Zsombok & Klein, 1997). This is done mainly by formulating descriptive models of experts' *naturalistic decision making* (NDM) skills as they are developed and used in real-world situations that are bound by time pressure, uncertainty, risk as well as vague and often contradictory goals and values (e.g., see Klein, 1989 for a model of recognition primed decision making). In contrast to game theory and other mostly experimentally grounded accounts of human decision making (e.g., Gigerenzer et al., 1999; Payne, Bettman, & Johnson, 1993), the NDM

approach is marked by an attempt to capture the rationality of experts' decision making in their natural task environments (see Lipshitz, Klein, Orasanu, & Salas, 2001). Although this effort is laudable, the NDM approach has been mainly criticized for a lack of conceptual rigor, particularly with respect to a formal account of the cognitive strategies people use to search for information in the environment, stop their search, and ultimately make decisions based on the information found (Bryant, 2002; Todd & Gigerenzer, 2001).

From a conceptual perspective, the present research constitutes an initial attempt at studying bounded rationality in a naturalistic context with the goal to reconcile the ecological validity of the NDM approach with the conceptual rigor underlying the concept of ecological rationality. This research approached bounded rationality not exclusively with conceptual goals in mind, however. Instead, from the perspective of cognitive systems engineering this study described and modeled real-world behavior with the goal of deriving knowledge that can be fed back and applied to improve the design of the work domain under study (e.g., Hollnagel, Woods, & Levenson, 2006; Rasmussen, 1986; Rasmussen, Pejtersen, Goodstein, 1994; Vicente, 1999). Although the present study was mainly concerned with generating such a knowledge base, the cognitive engineering challenge of generating 'useful' data will ultimately represent the most rigorous test for a conceptually guided study such as the present one.

The domain of choice for this study was Emergency Departments (ED) in U.S. hospitals. This domain is particularly suited for the study of bounded rationality because it requires physicians to make high-stake decisions with limited time and information, often under high workload, and in an environment that is marked by multiple, often

conflicting goals such as economic and medical standards as well as patients' needs and preferences. From the perspective of cognitive systems engineering, a better understanding of how ecologically rational physicians manage their patients and work demands as well as their medical and cognitive resources, may help to suggest grounded educational interventions for physicians in training and targeted decision support systems for practicing ED physicians. By identifying physicians' heuristics and describing the environment in which they are used, this research may help physicians become more aware of when their heuristics are effective and under what circumstances they are likely to result in negative outcomes and errors (e.g., Glatter, Martin, & Lex, 2008). Ultimately, by identifying and making available the skills underlying effective patient management, this research may benefit the emergency medical system by strengthening every day ED resilience.

This study used two methodological approaches to examine bounded rationality in the emergency department. The first methodological approach followed the NDM tradition and was grounded in observations of ED physicians practicing in their natural work environment. The first goal of this approach was to observe and identify the ecological clues ED physicians consider as well as the specific strategies they use to search for this information, stop their search, and ultimately make a patient management decision. To extend the NDM approach conceptually, a formal description of the observed decision strategies is not sufficient, however. Instead, it is necessary to identify why and when a particular strategy was used. That is, the second goal of this part of the research was to identify the degree of ecological (ir)rationality of the observed strategies

with respect to the problems, opportunities for action, values, and goals that are characteristic of the ED domain.

The second methodological approach used for this research adhered to a methodological framework hitherto used to study ecological rationality. That is, an experimental study was devised to complement the observational findings with a more controlled approach to studying bounded rationality in the ED. The specific goal of this part of the research was, first, to further disentangle the effects of certain ecological clue categories (e.g., patient characteristics) on physicians' reasoning and decision strategies. The second goal was to cross-validate and quantify the use of decision rules observed during the first part of this research, and the third goal was to identify potential additional strategies in a representative sample of ED physicians. Before these methodological approaches will be further elaborated, the following paragraphs will first provide a more thorough introduction to the concept of bounded rationality and elaborate on the bounds on rationality that are particular to ED domain.

Models of Bounded Rationality

Optimization under constraints

At least three different, partially contradicting interpretations of Simon's notion of bounded rationality (Simon, 1955, 1956) have been identified in the literature (see Gigerenzer & Selten, 2001; Gigerenzer et al., 1999). The first interpretation is espoused mainly by economists and retains the normative character of earlier decision making models by construing bounded rationality as *optimization under constraints* (e.g., Arrow, 2004; Sargent, 1993). To account for limited resource availability or to minimize decision costs, these models posit the *optimal* stopping rule, which contends that search efforts

will be discontinued when costs associated with further search start to exceed the benefits of obtaining additional information (e.g., Stigler, 1961). Although the goal of this approach is to model efficient search processes in a world of limited resources, the optimal decision rule often requires comprehensive knowledge about cost-benefit tradeoffs and vast computational power to perform cost-benefit calculations. The requirement of an *optimal* stopping rule makes the concept of optimization under constraints – just like the notion of an unbounded or perfectly rational ‘homo economicus’ – a poor psychological model of human rationality.

Biases and heuristics

The second interpretation of bounded rationality, the *bias and heuristics approach*, emphasizes mainly cognitive bounds on human rationality (Simon, 1955) stating that humans’ information processing capacity is inherently limited, constraining their ability to optimize choice or, more generally, decision processes (e.g., Kahneman, 2003). Experimental research in the 1970s and 1980s was designed to yield convincing evidence of peoples’ limited information processing capacities, which forces them to deviate from *normative* models of rationality and to resort to heuristic decision making, particularly if a task requires complex cognitive algorithms such as, for instance, Bayes’ theorem (e.g., Kahneman, Slovic, & Tversky, 1982; Lichtenstein, Fischhoff, & Phillips, 1982; Tversky & Kahneman, 1973). Although these heuristics may be effective in most cases, research indicated that they may “lead to severe and systematic errors,” biases, and fallacies with respect to *outcomes* prescribed by normative models of decision making (Tversky & Kahneman, 1974, p. 1124).

As a reaction to a plethora of laboratory studies performed to identify peoples' decision biases and fallacies, recent naturalistic studies of real-world decision making *processes* (as opposed to outcome evaluation) have accumulated contradictory empirical evidence. The main finding of the *naturalistic decision making* (NDM) tradition is that even though people satisfice, they tend to cope quite successfully with complex, real-world situations marked by time pressure, high workload, uncertainty, and vague goals (e.g., Klein et al., 1993; Zsombok & Klein, 1997). Moreover, in highly familiar environments experienced decision makers seem to use simple heuristics to search for relevant information, stop their search, make decisions, and, in general, effectively exploit environmental patterns to solve the task at hand (e.g., Klein, 1989). The data obtained from NDM studies are convincing because they describe decision processes as they occur in operational as opposed to laboratory settings. Moreover, results of NDM research have been successfully applied to cognitively engineer work environments and help practitioners cope more effectively with time pressure, risks, ambiguity, and additional team and/or organizational constraints (e.g., Crandall & Getchell-Reiter, 1993). However, despite its strong empirical grounding in natural phenomena the NDM approach has been criticized for a lack of formalization and conceptual rigor in defining cognitive processes such as information search, stopping, and decision rules (e.g., Bryant, 2002; Todd & Gigerenzer, 2001). As a consequence, the NDM tradition has yielded few testable hypotheses about the cognitive processes underlying boundedly rational behavior in the real-world let alone a conceptually satisfying rationale for the existence of skilled real-world behavior.

Ecological rationality

Formal models, testable hypotheses, and a conceptual framework explaining both bounded irrationality (cognitive biases and fallacies) and rationality (skilled behavior) have been provided more recently in a series of experimental and simulations studies (see Gigerenzer et al., 1999 for a summary of this research). Based on Brunswik's lens model¹ (1950, p. 16 ff.) and Simon's notion of bounded rationality (Simon, 1956, 1990), this third interpretation of bounded rationality suggests that the apparent contradiction between skilled and biased decision making can be conceptually reconciled by considering the rationality of cognitive *processes* (and outcomes) with respect to the cue structure of the decision environment or ecology (Gigerenzer et al., 1999; see also Smith, 2003). The study of '*ecological rationality*' refers to the analyses of a decision maker's set of cognitive algorithms or heuristics (his or her adaptive toolbox) and the evaluation of a heuristic's effectiveness in exploiting the probabilistic texture of cues that represent ecological constraints and opportunities with respect to a decision maker's goals (cf. Brunswik, 1950 and Tolman & Brunswik, 1934). Specifically, when confronted with a dynamic, information-rich, and uncertain environment, effective (i.e., ecologically rational) decision makers tend to choose simple heuristics that help them to extract the most predictive cues in the decision environment (the signal). Such fast and frugal

¹ Brunswik's lens model is based on two contentions. First, repeated events and relationships in an organism's environment form causal couplings and ultimately a causal texture, whereby one event is taken as the representative (cue) of another (vicarious mediation). Second, because such causal textures are never fully univocal, causal couplings are probabilistic in nature, i.e., differentially predictive. The lens model "bears resemblance to a bundle of rays scattering from a light source [the initial state] and brought back to convergence in a distant second point [the to-be-achieved goal state] by a convex lens [the sum of all available cues predictive of the goal state]" (Brunswik, 1950, p. 20). With this model, Brunswik provided a framework to think about how organisms functionally achieve their goals by selecting those ecological cues that are most predictive of their desired goal state (for probabilistic functionalism see also Brunswik, 1955).

heuristics are computationally tractable (respect cognitive bounds on rationality) and, by their very nature as simple cognitive strategies, tend to ignore those cues that are less prognostic or potentially misleading with respect to a desired outcome (the noise). By exploiting environmental structure that are prognostic with respect to goals and task requirements and ignoring those that are not, such simple heuristics may even outperform computationally more elaborate prediction models (e.g., regression models) that take into account the whole gamut of available information (e.g., Gigerenzer & Brighton, 2007; Gigerenzer et al., 1999). That is, if effectively attuned to a particular decision ecology and cue structure, fast and frugal heuristics can be effective instruments in people's adaptive toolbox to achieve desirable outcomes. Rational performance may be hampered and require a different cognitive strategy, however, if environmental conditions or the task to be accomplished change.

In sum, to formally investigate boundedly rational behavior, researchers must not only conceptualize peoples' *decisions (outcomes)* but also the *cognitive processes* underlying their decision making behavior. In addition, researchers must identify the *information cues* that are most predictive for a particular task as well as the ability of a cognitive process to exploit the ecological *cue structure* and yield *outcomes* that are *possible, desirable, or indispensable* given the task as well as the physical, organizational, and social context in which it is performed (Gigerenzer & Selten, 2001; Gigerenzer et al., 1999). With the goal of extending the experimental and computational evidence for ecological rational decision making, the present study aims to ground the investigation of bounded rationality in a naturalistic setting, the ED domain in the U.S.

Bounded Rationality in the Emergency Department

Hitherto, ecological rationality has been mainly researched in tightly controlled environments using narrow, laboratory-based decision making paradigms (Gigerenzer, Hell, & Blank, 1988; Gigerenzer & Hoffrage, 1995) or computer simulations (e.g., Gigerenzer & Brighton, 2007). These research methods often lack the time pressure, risks, ambiguity, and team and/or organizational constraints characteristic of real-world environments such as the ED. Naturalistic studies, on the other hand, provide an ecologically valid description of the web of constraints and bounds on rationality that can be found in actual decision environments but often lack conceptual grounding and rigor. In response to the attempt of “putting naturalistic decision making into the adaptive toolbox” (Todd & Gigerenzer, 2001), the present study aimed at grounding the study of ED physicians’ adaptive toolbox in their *actual* work environment, the ED. That is, grounded in the ecological validity of naturalistic observations, this study aimed at identifying ED physicians’ decision making strategies (i.e., information search strategies, stopping rules, and decision rules), the information cues they select, and the rationality of their cognitive strategies with respect to the goals and values characteristic of the ED ecology.

Decision points in the ED

Figure 1 displays an initial attempt at defining some of the major decision points and the dynamic interrelationship between these decisions as they pertain to the ED care delivery process. This framework conceptualizes care delivery as an interactive process between a physician and a patient (see Adler et al., 2002). In addition to the decision

points (center part of Figure 1) this figure captures their interrelationships with the physical, social, and organizational context in which patients and physicians interact and make decisions (the boxes at the top and bottom of Figure 1). Although this model may potentially be used to capture both patients' and physicians' decisions, the focus of this study was on ED physicians' decision making strategies. More specifically, given the complexity of care delivery decisions this research focused mainly on evaluation and disposition decisions (the black lines and boxes).

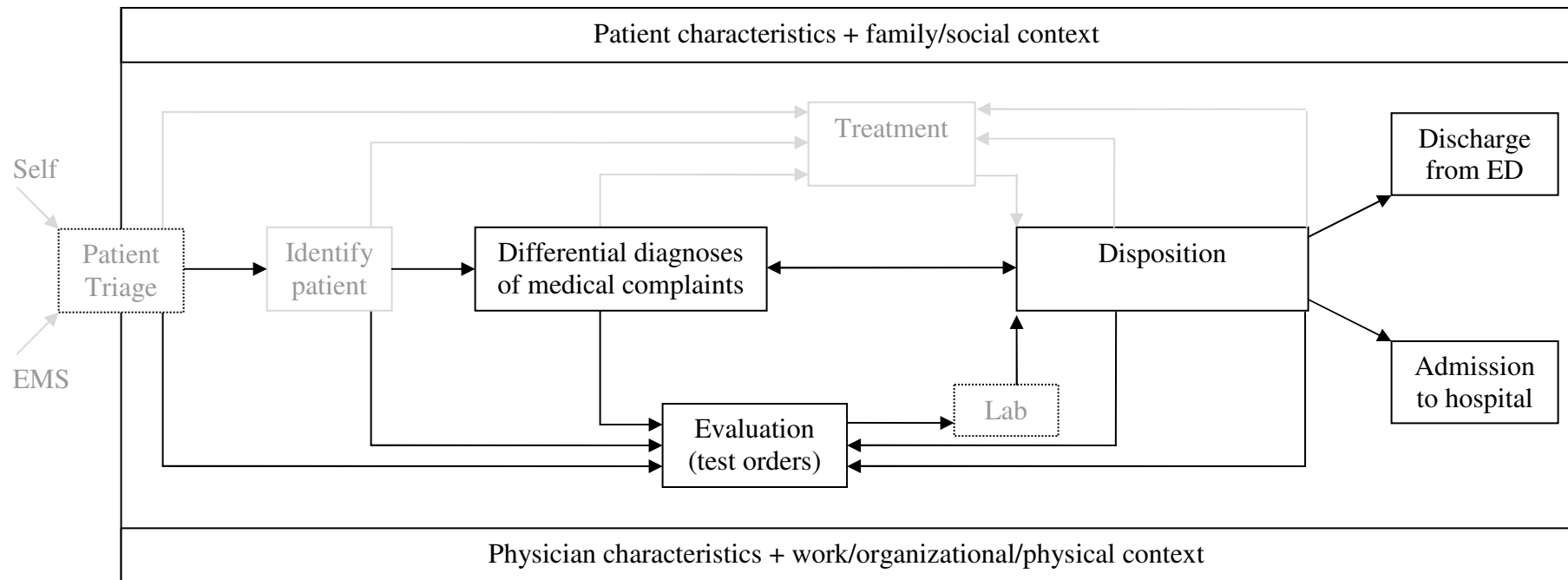


Figure 1. Tentative schema of decision points relevant to care delivery in the ED.

→ refers to decision pathways,

▭ marks decision points in the care delivery process.

If a patient is suffering from an emergent medical problem and requires immediate treatment (e.g., for major trauma or patients with an acute heart attack) physicians may use the triage decision to bypass further decision points in Figure 1 and directly perform stabilizing procedures and/or order lab tests (see arrows from triage to evaluation or treatment). If the patient is stable, the physician needs to delimit the range of possible medical problems that might underlie a patient's complaints. For the purpose of Figure 1, this decision is labeled *differential diagnosis*. Based on the space of possible medical problems (what to look for), the physician has to evaluate the patient (i.e., order tests/studies) to find out what caused the patient's problem(s) and how these problems might be best addressed. The next box in Figure 1 is labeled *disposition*. At this decision point the physician has to decide if s/he can do more for a particular ED patient and, if so, what can be done. In other words, the physician has to decide whether to continue or terminate care delivery in the ED. If results of treatments and/or tests confirmed a differential diagnosis, (stabilizing) treatment can be provided. If the results did not match the differential diagnosis or indicated another potential cause, the differential diagnosis may have to be revised and further treatments and/or tests may be warranted. This process may be iterated until physicians, patients, and/or both are satisfied with the care delivery process. If, on the other hand, resources to provide care in the ED are exhausted, the physician has to decide whether the patient should/can be admitted to the hospital (for observation or treatment) or be discharged and sent home. If the patient is to be *admitted*, the physician needs to decide where in the hospital the patient can/should be admitted. If the patient is to be *discharged*, the physician needs to decide how appropriate follow-up for the patient's medical problems can/should be best provided (e.g., by the primary care

physician, a specialist, or other appropriate health care providers including repeated visits to the ED). As can be seen in Figure 1, all of these decisions steps are interrelated in a circular dynamic in that differential diagnoses may impact disposition decisions as well as evaluation (and treatment) strategies. Conversely, likely (or anticipated) disposition decisions may impact the kind of evaluation procedures (and treatments) that are implemented in the ED as well as the range of differential diagnoses considered by the ED physician (see the arrows connecting decision points in Figure 1).

Moreover, any of these decisions may depend on patient characteristics (clues) such as sex, age, typical medical problems, and level of medical insurance as well as the patient's social and family context (see upper box in Figure 1). These context factors may be reflected in a patient's social and medical support system (e.g., availability of a relative or primary care physician), the credibility of a patient's 'story' as well as treatment preferences. Similarly, patient management decisions may depend on the physician's own characteristics such as training, work experience, medical specialization, and treatment preferences as well as the work, organizational, and physical context in which care is provided (see box at the bottom of Figure 1). In the case of an ED, the work context reflects the current level of patient load in the ED as well as all other situational variables influencing patient management (e.g., a patient surge after a major auto accident). The organizational context may consist of procedural regulations or conventions regarding care delivery as well as interactions with patients' primary care physicians, hospitalists, and/or social workers. The physical context relevant to physicians' decision making is reflected in the ED and waiting room capacity, the ED layout, and the physical availability of medical resources and laboratories. It was the goal

of the proposed research to identify physicians' evaluation and disposition strategies as well as the cues (e.g., medical cues, patient characteristics, and the work, organizational and physical variables) they consider in applying these processes to a particular situation and patient.

Ecological rationality in the ED

To what extent decision strategies are ecologically rational is typically evaluated with a focus on “multiple ... criteria – such as making decisions that are fast, frugal, and accurate – rather than on internal coherence” (Todd, Gigerenzer & The ABC Research Group, 1990, p. 775). Good measures to assess the simplicity and frugality of ED physicians' decision strategies are values such as the 10 minute door-to-ECG benchmark (recommended by the American College of Cardiology/American Heart Association) or simple counts of the number of cues and steps involved in making a decision. Medical accuracy, on the other hand, may be measured by comparing actual strategies to ‘text-book’ procedures established by medical authorities such as Rosen's Emergency Medicine compendium (Rosen, 2006). Measures of process simplicity, frugality and outcome accuracy may seem well suited to formally evaluate a particular strategy with respect to a well defined medical task or goal. With regard to the complexity of naturalistic settings, however, these generic criteria may not suffice to fully understand agents' ecological rationality. For example, anthropological research investigating peoples' every-day math skills has revealed that skilled, goal-driven behavior is domain-specific and is interactively negotiated between an agent, a physical environment, and an often covert but pervasive system of social values, assumptions, and accepted methods (Lave, 1987; see also Livingston, 1987 for a similar account based on ethnography). Any

description of boundedly rational behavior – be it a cognitive process or a behavioral outcome – must therefore be evaluated within the context of a specific *physical work space* (e.g., Hutchins, 1995a/b) and a diverse *social ecology* as it is reflected in domain-specific *goals*, accepted *methods*, and sociocultural *values* (e.g., see Forsythe, 1996; Suchman, 1986 for empirical evidence).

Conceptually, the distinction between externally (e.g., observer-defined) and domain-specific evaluation criteria is particularly relevant if the intended goal is to “lead research out of the ... conceptual cul de sac and to shift focus ... to human engineering” (Gigerenzer & Hoffrage, 1995, p. 685) of conducive decision environments and work support interventions (e.g., see Forsythe, 1996, 1998). One main characteristic of naturalistic settings is that they often accommodate multiple interest groups (e.g., physicians, patients, hospital administrators, and researchers) with diverse agendas and priorities. In such contexts it may depend on the chosen reference point whether a physician’s decision is judged an effective heuristic (e.g., when a treatment helps the patient to relax) or a cognitive bias (e.g., it may be uneconomical to provide). If the research goal is to understand ecological rationality in a naturalistic setting and ultimately apply this knowledge in the field, research must identify not only cognitive processes and decision cues but also the values and assumptions that relevant interest groups use as a yardstick to evaluate practitioners’ performance (e.g., Forsythe, 1996, 1998). The next paragraphs provide a preliminary description of categories of ED-specific constraints, values, and assumptions that – apart from standard measures of simplicity, frugality, and accuracy – were considered relevant when evaluating the ecological rationality of ED physicians who use a particular cognitive strategy on a specific set of decision cues.

Sociocultural values in U.S. medicine. At a very basic level, one set of criteria that is relevant to physicians' behavior is a socially agreed upon value system that defines what it means to be sick and determines how this state of sickness is to be treated. Disease and medical treatment in the U.S. (and most other Western countries) is hitherto mainly defined from a mechanistic, biomedical perspective with only little credit being given to social and/or psychological determinants of disease (cf. Adler et al., 2002; Shi & Singh, 2008). One outgrowth of this perspective is the reliance on evidence-based medicine (e.g., Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996) and acceptance of medical technology as the preferred means for diagnosis and treatment. More specifically, public health specialists have recognized that care providers in the U.S. health care system emphasize (and their patients expect) specialized, mostly technology-based treatment of esoteric diseases over the delivery of population-wide primary care (Shi & Singh, 2008). In such an environment, it is ecologically rational for physicians (and maybe even necessary to be able to bill for their services) to use elaborate medical technologies and procedures to justify their diagnostic and treatment decisions. This may be so even if a thorough physical exam and short conversation with the patient could have ruled out the need for more expensive testing. If the use of evidence-based treatment is legally enforced, this trend may lead to the practice of defensive medicine, which describes physicians who overuse certain technologies and/or order additional tests and medications, not because these measures are medically necessary, but to thwart opportunities for malpractice litigation (e.g., Studdert, 2005; Tancredi & Barondess, 1978).

Further, the U.S. society is marked by a strong capitalist orientation that has led to a mostly privatized health care system with approximately 60% of care providers and insurance companies being privately owned for-profit organizations. This free market orientation has two main implications for health care delivery in the U.S. First, access to scarce medical resources is dependent on adequate coverage. Although there are regulations in place to guarantee care to the poor (Medicaid), elderly (Medicare), and uninsured children from low-income families (the State Children's Health Insurance Program: SCHIP), ecologically rational physicians must consider economic viability when allocating health care resources. Second, in a market-oriented health care system, providers are in competition requiring hospitals and physicians to provide care in a way that helps to attract and maintain customers as well as their insurance companies.

Finally, the U.S. society is characterized by an emphasis on consumer convenience. This emphasis can also be seen in health care institutions such as urgent care centers and walk-in clinics, which are a U.S.-specific phenomenon that cannot be found in, for example, European health care systems. Research has found that these clinics are mainly frequented for basic medical needs, due to their convenient location and hours of operation (e.g., Bell & Szafran, 1992) as well as their no-appointment philosophy (Rizos, Anglin, Grava-Gubins, & Lazar, 1990). Given the competitiveness of the U.S. medical system and the fact that local Eds provide comprehensive care 24/7, it is likely that convenience of care delivery is an ecological criterion relevant to ED physicians' decision making processes.

Emergency Medicine in the U.S. The credo of emergency medicine in the U.S. is, and has been since its inception as a medical specialty in the 1960s, to provide 'anyone'

in need of medical care with ‘anything’ that can medically be done at ‘anytime’ (Zink, 2006). In 1985, fueled by a number of publicized cases of severe medical neglect, this principle has been legally enforced by the Emergency Medical Treatment and Active Labor Act (EMTALA). By legally guaranteeing necessary medical care to *any individual* (Bitterman, 2001), EMTALA made Emergency Departments (ED) a vital aspect of the U.S. health care system as a safety net, particularly for the indigent and growing population of uninsured patients (Gordon, 2000). Recently, research has identified several developments and challenges to the U.S. emergency medical system that may ultimately compromise patient safety and potentially jeopardize the reliability of the U.S. emergency care system (IOM, 2006; Trzeciak & Rivers, 2003). For instance, while Eds have experienced a 20% increase in the number of visits per year between 1995 and 2005 (reaching an all-time high of 115.3 million patients in 2005, NCHS, 2007) the number of Eds in the same period declined by 9% from 4,176 to 3,795 (Fields, 1999). In approximately the same period, the number of hospital beds declined by 198,000 (IOM, 2006). Simultaneously, a steady increase in the number of uninsured patients made the ED in 2006 the only available medical resource for about 47 million or 15.8% of the U.S. population (U.S. census bureau, 2007). Finally, a growing proportion of ED patients requires specialized treatments and increased attention as is the case for children under 15 years of age (21% of all ED visits; NCHS, 2007), the elderly above 65 years (14.5% of all ED visits), and an increasing proportion of severely ill (Derlet, 2002; Lambe, 2002).

In summary, given the emphasis on technology- and evidence-based medicine, the strong regulatory environment surrounding ED care (e.g., EMTALA), and the pervasive litigation threat in the U.S. medical system, it may seem eco-logical for ED physicians to

provide supplementary testing or treatment (see Studdert et al., 2005 for a recent account of defensive medicine). On the other hand, a steadily growing influx of patients with special needs requires fast, frugal and economically efficient patient management strategies. To satisfy their patients' medical needs reliably, safely, and in a timely manner, ED physicians may need to trade off medical safety with efficiency as well as patients' needs with available resources while simultaneously respecting organizationally enforced guidelines and regulations. Depending on the patient population and geographical location of an ED, its available physical resources (e.g., bed capacities, ED compartments that are equipped for urgent medical cases), and physical structures (e.g., ED size, layout) ED physicians are likely to develop a set of strategies to cope with this domain-specific web of constraints. By studying actual ED physicians in their natural environment, this research aimed to identify the set of strategies they have developed to achieve acceptable performance with respect to medical requirements while simultaneously respecting constraints on action such as resource limitations.

Introduction Summary

If time and resources permit there may be several, equally workable solutions physicians can choose from to effectively manage ED patients. However, what constitutes an effective (rational) patient management strategy becomes increasingly constrained (bound) by challenges such as increased workload, the needs of a diverse patient population, and a set of legally or organizationally enforced regulations. Under circumstances that require boundedly rational strategies, some solutions may be faster and yield higher leverage than others. Whereas each physician is likely to exhibit slightly different patient management strategies to work around and within these constraints, after

repeated exposure to a certain kind of task and a certain kind of situation ED physicians are likely to attune their practice to functionally salient information in their environment. That is, they will start to employ ‘smart’ solutions that can “capitalize on the peculiarities of the situation and the task” (Runeson, 1977, p. 174). Peculiarities of a domain (e.g., EDs in the U.S.) are those *information cues* that are most predictive of desirable performance on a task such as patient management. Thus, if fast and frugal strategies (i.e., heuristics) are attuned to the peculiarities of a domain they provide decision makers with an efficient and robust method to separate information cues (signal) from irrelevant (noise) or potentially misleading information (e.g., Gigerenzer & Brighton, 2007; see also Gigerenzer et al., 1999).

If experienced decision makers learn to capitalize on the statistical, physical, and social information patterns in a particular decision environment, their fast and frugal heuristics should no longer be interpreted as cognitive biases, fallacies, or errors with respect to a normative standard (see bias and heuristics approach). Instead, because ecologically ‘smart’ heuristics (and biases) ignore irrelevant information and target those cues that are most predictive of a desired outcome, they should be considered ‘good enough,’ efficient, and robust procedures in the decision maker’s adaptive tool box (Gigerenzer et al., 1999; Gigerenzer & Selten, 2001). The present research focuses on identifying the functionally salient structure of the ED domain as well as ‘smart,’ ecologically rational strategies ED physicians use to exploit this structure.

The present research and the concept of bounded rationality

The notion of bounded rationality has yielded several research traditions, construing rationality as optimization under constraints, with respect to a normative

model (the bias and heuristics approach), or with respect to a specific physical and social ecological context. The latter research tradition has hitherto mainly focused either on describing real-world experts' decision making in a naturalistic context (e.g., Klein et al., 1993; Zsombok & Klein, 1997) or on formally modeling decision making rules and environments in the context of controlled laboratory tasks and computer simulations (e.g., Gigerenzer et al., 1999; Gigerenzer & Selten, 2001). Whereas the former approach lacks formalization of observed decision processes, the latter approach lacks empirical grounding of formal models in a naturalistic context. Thus, the conceptual goals of the proposed study were threefold. First, it aimed at providing empirical evidence about if, when, and how real-world experts (i.e., physicians) use fast and frugal heuristics in a naturalistic context (i.e., the ED). Second, this study aimed at describing the specific clues these heuristics are adapted to. And third, this study evaluated to what extent heuristics that exploit those clues are ecologically rational with respect to a naturalistic context that is marked by multiple, often conflicting goals, assumptions, and sociocultural values.

To achieve these goals two methodological approaches were taken. Based on naturalistic observations, a first approach generated a formal description of the decision rules and cues physicians used to make their care delivery/patient management decisions in the ED². The ecological rationality of these strategies was evaluated with respect to domain-specific values and goals as well as with regard to standard criteria of decision process simplicity and frugality. A second, experimental part used paper-and-pencil

² To gain insight into the rules as well as the cues ED physicians use/select (often tacitly), the emphasis during observations was on the educational (verbal) exchange between Resident physicians and supervising Attending physicians. The method section for the observational study will provide a rationale for using this procedure and a more detailed description of how it will allow insights into ED physicians' care delivery strategies.

surveys to cross-validate the observed decision strategies, to quantitatively capture the kinds of decision strategies ED physicians use, and to test specific hypotheses that could not be answered using observational methods alone. Specifically, this part was devised to disentangle the extent to which physicians' decision strategies are adapted to specific medical, physical, or social structures of the ED environment. A more detailed description of this two-step procedure will be provided in the Method section.

The present research and the ED domain

Whereas the U.S. health and emergency care system is recognized as the most advanced and sophisticated in the world, there is empirical evidence that ED workers at the 'sharp end' are presently operating at their limits leaving few additional resources to cope with further increasing or unforeseen challenges (e.g., Pines & Hollander, 2008; Pines, Hollander, Localio, & Metlay, 2006; Wears & Woods, 2007). To support and maintain safety during situations of high workload, time pressure, and stress, human factors interventions have traditionally focused on eliminating and/or reducing human errors, biases, and heuristics (i.e., faulty decisions or actions) as they result from basic information processing limitations (Norman, 1981; Reason, 1990) or systemic constraints (e.g., Bogner, 1994). Although human error has been identified as one of the major contributors to sub-optimal performance in medicine (e.g., Bogner, 1994; Glatter et al., 2008; Leape, 1994, 2004), the flexibility of skilled physicians, nurses, and staff are – from a cognitive systems engineering perspective – currently the only widely available resource that can help make emergency care delivery resilient and safe at the sharp end (e.g., Cook & Woods, 1994; Wears & Woods, 2007). By identifying the fit between environmental structures and physicians' decision strategies, this research yielded a

description of ED physicians' heuristics and the extent to which they are ecologically (and socially) rational with respect to the goals, values, and assumptions prevailing in the ED domain. An improved understanding of ecologically rational heuristics may be used to devise targeted training and/or decision support interventions. Although research into ecologically rational behavior tends to focus on the adaptation process and deemphasize outcome evaluation (Gigerenzer & Selten, 2001, p.4), a naturalistic perspective can provide valuable insight into what actually drives physicians' behavior in the context of the ED domain. A better understanding of physicians' goals and values makes explicit under what circumstances physicians' heuristics yield fast, frugal, and accurate (i.e., ecologically rational) decisions and help identify and circumvent situations when heuristics are likely to result in systematic errors, biases, and potentially disastrous outcomes. Information that helps recognize circumstances when heuristics become biases will allow practitioners to make more conscious and targeted use of their decision strategies and ultimately provide health care more safely and reliably.

Research Overview

Two methodological approaches were used for this research project, an observational and an experimental study. First, naturalistic observations of ED physicians were performed to generate a knowledge base about physicians' every-day patient management strategies. Specifically, the study used observational methods to investigate physicians' evaluation and disposition *decisions*, the cognitive *processes* and *cues* they were using to come to care delivery decisions as well as the *goals* and *values* that were underlying their decision making. The first goal of this study was to generate a formal description of the information search, stopping, and decision rules ED physicians use on

an every-day basis. The second goal was to identify the ecological clue categories ED physicians consider when using these information search, stopping, and decision rules to make evaluation and disposition decisions for their patients. Finally, the third goal of this study was to evaluate the extent to which the observed decision processes and outcomes were ecologically rational with respect to the goals and values of the ED domain.

The second methodological approach (i.e., the survey study) aimed at extending and cross-validating the observational findings in an experimental setting. A case description was developed with the goal of disentangling the impact of specific ecological structures on ED physicians' reasoning and decision making (the first goal of this study). The case description was based on a common medical complaint and contained a manipulation of patient characteristics. After interpreting the experimental data, the obtained results were compared to the observational findings to systematically evaluate the prevalence of the observed decision strategies in a more representative sample of ED physicians (the second goal of this study) and identify potential additional decision strategies (the third goal of this study). The observational and experimental studies will be described in turn. After presenting methodological approaches, results, and the discussion of results for each study separately, a general discussion section will summarize the findings.

II. OBSERVATIONAL STUDY METHOD

The Observed Settings

This study used naturalistic observations to investigate ED physicians' every day care delivery (i.e., evaluation and disposition) decisions. Observations took place in two Eds associated with two Midwestern hospitals, Good Samaritan Hospital (GSH) and Kettering Medical Center (KMC). Both hospitals are teaching hospitals affiliated with the Boonschoft School of Medicine at Wright State University, a midsize, Midwestern university. Both GSH and KMC are staffed by the same physician group (i.e., the physicians are administrated by the same organization) but differ along several organizational dimensions and with respect to characteristics of the patient populations they serve. GSH is the larger of the two Eds consisting of 4 different work areas each with approximately 10 beds. Physicians at GSH use electronic record and ordering systems to serve an ethnically and socioeconomically diverse population. However, the typical patient frequenting GSH is African American, often without insurance, and suffers from severe and acute medical problems such as heart attacks, organ failures, or drug overdoses. KMC, on the other hand, is physically organized around 3 work areas each with approximately 6 to 8 beds. Physicians use a paper-based record system (t-sheets) in combination with an electronic database that is used to store and display laboratory results. The patient population at KMC is less diverse with respect to ethnic and socioeconomic variables. Specifically, the typical patient frequenting KMC is geriatric, Caucasian, middle-class, insured, and often presents with chronic complaints

such as chest pain or shortness of breath. Both EDs have a sizable population of urgent care patients who present with minor medical problems.

Participants

For this study, 3 attending ED physicians were observed at each of the two hospital Eds during a normal work shift of 8 to 10 hours. Attending physicians were selected mainly on the basis of their willingness to participate in the present study. However, it was attempted to select attending physicians with at least 5 years of clinical experience after the residency. At GSH, one attending physician had 3 years, one more than 10 years, and one 26 years of clinical experience after having finished residency. At KMC, one attending had 5 years, one 24 years, and the third attending physician had 28 years of clinical experience beyond residency. In addition to attending physicians, 6 resident ED physicians were shadowed at each hospital. The observed resident physicians were chosen based on willingness to participate in the study and their tenure in the emergency medicine residency program at Wright State University. Specifically, two first, second, and third-year residents were shadowed at both GSH and KMC for the duration of a single work shift of 10 hours.

Procedure

This study was fully approved by human subject committees at both hospitals (GSH and KMC) as well as Wright State University. All participants were approached via email or in person in the ED in accordance with human subject regulations. A copy of the recruiting email can be found in Appendix I.1. Before starting observations, participants signed and received a personal copy of the approved consent form (for a copy of the consent form see Appendix I.2).

To maintain the unobtrusive character of observational methods, each session was performed by a single researcher. Due to availability and time limitations, most observations were performed by the same researcher. Data of one second and third ED Resident at KMC as well as one attending ED physician at GSH was collected by a second researcher to increase the richness of the data considered for analysis. Both researchers discussed and agreed on how to conduct unobtrusive observations³. Specifically, researchers were silent observers and asked questions to clarify what has been observed only if needed and when physicians were *not* engaged in care delivery activities such as patient interviews, record keeping, or communication with patients, fellow physicians, or other ED staff. Both observers logged overt behaviors, verbal and non-verbal communications, as well as situation-specific events/information related to, for example, informal interactions between ED staff, new incoming patients, or the number of patients in the ED/waiting room. Given the purpose of this study, data protocols were focused on care delivery decisions such as physicians' differential diagnoses, test/study orders, as well as disposition (i.e., admit or discharge) decisions. A stop watch was used to collect and record time stamps for all observations at the level of meaningful care delivery units such as the start and end of physician-patient interactions, the time of test orders and reviews as well as the time of admission/discharge. The main reason for using time stamps was to be able to easily manage the data during analyses⁴. In total, 18 protocols were logged for the present study. Given that the length of these

³ The first observer trained the second observer. Specifically, the second observer performed several practice observations. Logged protocols were then discussed with the first observer. Inconsistencies and limitations of the data collection procedure were identified and iteratively implemented in later observation sessions.

⁴ Another reason for logging time stamps was to potentially identify how patient care is spread out over the course of physicians' work shifts. However, the diversity and situation-specific nature of the observed cases did not allow meaningful comparisons between different courses of care delivery.

protocols averaged 20 type-written pages the bulk of the raw data is not included in this document. However, a sample protocol can be reviewed in Appendix II.1.

Attending-Resident interactions

One particular focus of the observations was the educational and clinical exchange between resident and attending ED physicians. As has been shown by previous research, the verbal exchange between Attending and Resident provides researchers/observers with information about clinical reasoning strategies and rationales for care delivery decisions that are often not verbalized if a physician is practicing by him/herself (cf. Shalin & Bertram, 1996). Based on the present research, the benefit of observing resident-attending interactions was that resident physicians first gathered case relevant information and then provided and discussed relevant findings with the supervising attending physician. After having obtained a Resident's initial case description attending physicians often asked specific follow-up questions to obtain additional information before they agreed on a specific treatment and evaluation plan. Because both resident and attending physicians tend to explicitly verbalize their thoughts and rationales, their interactions provided valuable information with respect to the clue categories ED physicians attend to as well as the strategy they used to search for information, stop the search, and ultimately make a decision. In other words, Attending-Resident interactions provided valuable information with respect to the heuristics in ED physicians' adaptive toolbox.

More specifically, a quasi-developmental comparison⁵ between attending physicians' care delivery strategies and those used by less experienced first, second, or third-year Residents allowed the analysis of differences in ED physicians' decision strategies. That is, in some circumstances, (often more experienced) resident physicians suggested care delivery strategies that were in agreement with or immediately satisfied the expectations of the attending physician. In other situations, (less experienced) resident physicians suggested care delivery approaches that had to be corrected or were 'overruled' by the supervising attending physician. Thus, conversations between attending and resident physicians provided insight into when and how resident physicians used limited resources effectively to address the problem at hand. On the other hand, Attending-Resident interactions also revealed when resident physicians' limited knowledge and/or lack of clinical experience lead them to suggest ineffective care delivery strategies. Under these circumstances, attending physicians stated explicitly how and why to improve the Resident's care delivery strategy, for example, by taking advantage of specific ecological constraints.

Data Evaluation

The results of the present study are based on an extensive coding, evaluation, and reevaluation process. Up to four researchers worked through and discussed the protocol data to identify a coding scheme that could be used to parse the wealth of observational data in a way that was conceptually meaningful with respect to the goals of this study. Given the wealth of data, attempts at double-coding protocols were abandoned and

⁵ A complete and meaningful analysis of developmental and expertise differences in ED physicians' care delivery strategies could not be performed with the obtained protocols due to lack of data for (more) participants at different levels of clinical expertise (i.e., first, second, and third-year resident and attending physicians). Future research will be necessary to identify the developmental differences in ED physicians' decision making skills.

protocols were coded by a single researcher only. To guarantee a modest level of interrater reliability, coding schemes used to categorize the data were developed in a cooperative and iterative effort. For each coding scheme that was applied to the data, two researchers coded at least parts of a protocol. The results of this initial coding process were then discussed with other researchers to identify disagreements and agree on a commonly acceptable resolution of these differences. If differences could not be eliminated via discussion, the coding scheme was revised and the process started anew.

At the outset and with respect of the first goal of this study, fields notes were reviewed with respect to the kinds of medical complaints that occurred during the observed shifts. However, analyses revealed not only a wide range of different medical problems but a seemingly diverse set of different strategies ED physicians' used to deal with a particular medical problem. This made consistent categorization of the data difficult. Sample codings used to assess interrater reliability averaged between $\alpha = .3$ and $\alpha = .5$. Another coding strategy, based on criteria predefined by the researcher, was used to categorize major classes of decision outcomes, processes, goals, and decision clues. The goal of this approach was to detect systematic differences in these measures with respect to the observed classes of medical complaints and with regard to context variables such as physicians' level of clinical experience in the ED, observed work shift (e.g., time of day), ED setting (KMC or GSH), and patient characteristics (e.g., sex, age, insurance status). Sample codings used to assess interrater reliability averaged between $\alpha = .3$ and $\alpha = .6$. Similar to the coding scheme described previously, categorization was difficult. In this case, the main problem was lack of sufficient data for a meaningful comparison of most of the predefined categories (e.g., observations took place at two hospitals, there

were only 2 or 3 participants for each level of clinical experience and observed work shift). After several attempts to modify both of the initial data coding procedures, these coding approaches were abandoned.

For the third and final approach, coding focused on the identification of the clue categories the observed ED physicians considered when making evaluation and disposition decisions (i.e., the second goal of this study). Based on the categorization of the protocol data with respect to the kinds of clues used, data could be more easily parsed into meaningful categories. Sample codings used to assess interrater reliability averaged between $\alpha = .6$ and $\alpha = .8$. In other words, whereas individual cases were unique in their medical requirements as well as the patient's particular needs, similar clue categories were used for dissimilar medical problems across a diverse patient population. Although the initial data coding approach made it difficult to identify the types of strategies ED physicians used to process certain types of information, once repeatedly used categories of information were identified, it was rather easy to understand how and why the observed ED physicians made use of this data. Specifically, with respect to the identification of information search, stopping, and decision rules (i.e., the first goal of this research), this clue-focused coding scheme suggested that ED physicians did not use different kinds of heuristics for different types of medical problems. Instead, the categorization of clue categories suggested that these clues were used to adapt a small number of general heuristics to the particular case at hand.

In summary, the main coding strategy for this study was based on an iterative bootstrapping process. On one hand, the purpose of this process was to identify how different clue categories shaped the use of ED physicians' general heuristic strategies

(i.e., to address the second goal of this study). Conversely, the identified variations and similarities in ED physicians' strategies provided insights into the formal properties – the information search, stopping, and decision rules – of their general heuristics (i.e., the first goal of this study). In turn, information about the fundamental nature of these heuristics helped to understand *why* they were used (i.e., their ecological rationality) given the goals, values, and characteristic constraints of the ED domain (i.e., address the third goal of this study).

III. OBSERVATIONAL STUDY RESULTS AND DISCUSSION

Overview

The major finding emerging from the analysis of the protocol data is that ED physicians possess a domain-specific toolbox of decision strategies (Geertz, 1986; Gigerenzer et al., 1999, Lave, 1987). That is, the observed heuristics are ED physicians' adaptive responses to domain-specific sociocultural norms (e.g., value systems, legal regulations, emergency medical training) and direct experience with the constraints inherent in the ED domain (e.g., time pressure, resource limitations). Observations suggested that ED physicians use domain-specific constraints to effectively delimit the problem to be solved as well as the range of reasonable courses of action to address this problem without the need to engage in extensive computational processing. In other words, the observed ED physicians delimited problems and selected heuristics that leveraged *environmental* constraints to reduce the set of possibilities to be considered. By doing so, they were often able to limit decision alternatives to few if not a single 'obvious' and workable solution strategy (for similar findings in real-world experts see Klein, Calderwood, & Clinton-Cirocco, 1989; Rasmussen & Jensen, 1973).

The conceptual goal of this study was threefold. The first goal was to provide empirical evidence whether, when, and how ED physicians use (fast and frugal) heuristics in the ED. Emergency medicine is provided under multiple pressures such as strict legal regulations that define adequate and 'safe' medical care (cf. Bitterman, 2001) as well as increasing patient volumes (IOM, 2006) and resource limitations that require swift and efficient care delivery. Based on the observations, ED physicians employed two

general heuristics that correspond to and complement each other with respect to the conflicting values of safe and efficient emergency care. In the first part of this section, illustrative examples from the observations will be provided to ultimately arrive at a formal definition of these two general heuristics.

The second goal of this study was to describe the specific ecological clues ED physicians consider when making evaluation and disposition decisions. One main finding of this study was that evaluation and disposition decisions are tightly interconnected in that ED physicians' main goal is to evaluate not for diagnoses but for swift and correct disposition. Observations revealed that ED physicians use ecological constraints/clues to delimit both the range of a patient's possible medical problems (i.e., the problem space to be evaluated) as well as the range of the patient's possible disposition (i.e., the available solution space). By doing so, they are able to delimit the problem to be solved and identify the most adequate heuristic to address this problem. For conceptual clarity, the specific constraints/clues ED physicians used to (re)restructure the problem and solution spaces will be described in turn, in the second and third part of this section.

The third goal of this study was to evaluate the extent to which physicians' decision strategies are ecologically rational given the particular constraints of the ED domain in the U.S. ED physicians' ecological rationality is a direct consequence of the findings presented in the previous three parts of this section, which will therefore be described in a summary section.

Finally, observations revealed that emergency care delivery cannot be completely understood with an exclusive focus on formally defined functional requirements for safe and efficient care. Rather, the formally and medically defined service of emergency care

is delivered in an informal social environment that is marked by cooperation and (mis)communications between physicians, patients, their family and friends, as well as other ED staff. Observations identified that ED physicians' adaptive toolbox contains strategies to perform the 'hidden work' necessary to cope with the social dynamics underlying emergency care delivery. Moreover, findings suggest that these strategies have not only moral or esthetical value but may be functionally beneficial to providing safe and efficient emergency care. The final part in this section will conclude with a description of ED physicians' informal (i.e., 'hidden') social skills and strategies.

Prelude: The ED as an ill-structured domain

In the context of the present discussion, environments are defined functionally with respect to a particular task, goal, or problem. To be able to talk meaningfully about functional environments such as emergency departments in the U.S., it is necessary to describe task-relevant characteristics and structures of the domain environment in generic terms. The hope is that an abstract description of task-relevant environmental structures will provide a coherent framework to discuss and summarize the findings of this research in the emergency medical domain. The following categorization scheme is based on the attempt by Reitman (1964, 1965) and Simon (1973) to characterize the functional structure of ill-defined problems.

The class of problems discussed by both authors "involve the transformation or creation of states, objects, or collections of objects" (Reitman, 1964, p. 283). In the ED domain, care delivery involves the use of objects such as medications, medical technology, and individual care to transform patients' states of disease into states of health (or at least some stable state of functioning). Ill-defined or ill-structured problems

are essentially problems that have ‘open constraints’ which refer to “one or more parameters the values of which are left unspecified as the problem is given to the problem solving system from outside or transmitted within the system over time” (Reitman, 1965, p. 144). In (emergency) medicine, initial states (i.e., the “disease” or the patient’s problem) and goal states (i.e., “health” or other care delivery outcomes) as well as transformation strategies (the “adequate” treatment) are often loosely defined until “conditions are added and the problem is converted to some standard well-defined form” (Reitman, 1964, p. 293). This leaves ED physicians with the task to find ways and use strategies that help fill open constraints prior to and during the implementation of a solution to their patients’ problems.

On one hand, open constraints necessitate actors to spell out hitherto underspecified problem and goal definitions (e.g., Shalin & Bertram, 1996) and/or undetermined solution strategies. On the other, “frequently it is just exactly the openness of certain constraints that makes a solution of the problem possible” (Reitman, 1964, p. 293). That is, problem solvers can take advantage of the ‘definitional slack’ open constraints provide by flexibly adjusting parameters to fit the situation at hand. In general terms, the environmental structure (or the problem space) relevant to emergency care delivery is not necessarily a given but has to be negotiated between the actor(s) involved (e.g., the physician, the patient, family, nurses, consultant specialists), the problem space (e.g., the disease, patients’ preferences) as well as the solution space (e.g., physical constraints such as the availability of specialized medical technology or bed capacities as well as social/organizational constraints and value systems).

The focus on how “the interaction between a heuristic and its social, institutional, or physical environment” can yield effective, fast, and frugal decisions has been the hallmark of the ecological rationality paradigm (Todd & Gigerenzer, 2007, p. 167). Research into ecological rationality has hitherto mainly focused on explaining the fit between certain heuristics and task environments, which were pre-defined by the experimenters and considered fixed for the task at hand⁶ (e.g., Gigerenzer et al., 1999). However, it has been recognized in the early problem solving literature (and confirmed by the present study) that “In real [naturalistic] thinking processes, [the meanings of] items often do not remain rigidly identical; and as a matter of fact, precisely their change, their improvement is required [because] Blindness to such a change of meaning often impedes productive processes” (Wertheimer, 1959, p. 259). In Reitman’s terms, the number of ‘open’ and ‘closed’ constraints inherent in (health) problems, (care delivery) goals, and appropriate (treatment) strategies may not be stable but dynamically changing based on the interactions of a problem solver (and other stakeholders in the solution process) with the problem and solution spaces (cf. Simon, 1973). Thus, to provide insight into how ED physicians determine (or better negotiate) what environment they are in and, given this situational definition, how they select and adjust their clinical algorithms, it is necessary to explain behavior in the ecologically rich context in which it is made. That is, the conceptual perspective on ‘environments’ must be broadened to include task definitions that consider ‘open constraints’ and depend on how these constraints may, should, or must be closed by the decision maker(s) (i.e., the available solution space).

⁶ Similar arguments have been raised in the problem solving literature with respect to research focusing almost exclusively on pre-defined (i.e., well-defined) problems; for a generalized statement see Reitman (1964); for an example in the medical field see Shalin & Bertram (1996).

The following Parts I-IV will describe different strategies the observed ED physicians used to close open constraints inherent in every-day care delivery problems.

Part I: General Heuristics in ED Physicians' Adaptive Toolbox

Excerpt 1:

Attending: [The practice of Emergency Medicine] is all about efficient prioritization. The first question is 'sick' or 'not sick.'

Excerpt 2:

Attending: I had 32 people on average in an 8 hour shift. I was a gatekeeper: you're sick, you're not sick. We had over 300 patients a day.

Excerpt 3:

Attending: Most often there is no diagnosis ... actually, if we have one, that's a bad thing! I tell my patients: You don't want us to have an exact diagnosis, that's bad.

Although potentially surprising to those unfamiliar with emergency medical thinking, these Excerpts suggest that ED physicians' central or essential task is *not* the exact diagnosis of a medical problem ('most often there is no diagnosis') but rather to ascertain problem acuity⁷ (i.e., to identify whether patients are 'sick' or 'not sick') and determine adequate follow-up care for the nature of the patient's problem (i.e., to decide whether and where to admit or discharge a patient). As will become apparent from the example cases provided below, it is the loosely defined categorization of patient into 'sick' versus 'not sick,' which provides ED physicians, at the same time, with the structure *and* 'definitional slack' necessary for efficient care delivery. That is, on one

⁷ Acuity is a technical term used to refer to the severity as well as the acute versus chronic state of a patient's medical problem. High acuity refers to a severe and highly acute problem. This term is used with respect to the management of resources and workload, particularly in the ED (for an explanation and critique of the term see Sage, 2008).

hand, ED physicians use this ‘simple’ categorization problem to effectively constrain the kinds of information for which they search, to decide when to stop their search, and ultimately, to disposition a patient. On the other hand, the exact definition of what it means for a particular patient to be ‘sick’ or ‘not sick’ is less clear-cut and ED physicians’ can exploit this ‘definitional slack’ to adapt care delivery strategies to the specific case at hand. Case 1 provides an example in illustration of these points.

Case 1

A Resident reports to an Attending about an 80 year old patient.

Resident: This guy is scary. He had peripheral vascular disease, DVT [deep vein thrombosis], CAO [coronary artery obstruction] and hypertension. He also has a history of COPD [chronic obstructive pulmonary disease]. His complaint started last night. He was acutely short of breath in the morning. He is not the best historian, though. He sats at 80% [the patient’s blood is oxygenated to 80%], denies fever/chills, he is always cold. He has lower extremity edema but he hasn’t taken his meds as he should.

Attending: [The Attending checks the patient’s previous medical history in the computer system] Seems like it’s his yearly visit.

Resident: I think he has COPD exacerbation and some viral thing.

Attending: He was admitted for DVT in ’01. He had leukemia in the past. Scan him because of his history; forget the d-dimer⁸, he is high risk already.

Resident: ...do the obligatory cardiac work up?

Attending: Yes.
[]

The resident checks the values for the patient’s cardiac enzymes⁹, which had been run in triage.

Resident: They are up a little.

Attending: *He is staying anyway. That’s not too bad: .03 and .04* [for the Troponin value] *is still ok. It is very unlikely he has an MI* [myocardial infarction]. As soon as

we get the reading [for the CAT scan] back, *call [the admitting physician] and tell him about the patient.*

In this case, it was clear to the Attending physician that the patient was ‘sick’ and required admission to the hospital but the physician was not concerned about additional testing due to a slight elevation in the patient’s Troponin value (a cardiac enzyme indicating damages to the heart muscle) because ‘he is staying anyway.’ That is, because the patient’s Troponin value was ‘not too bad’ and ‘it [was] very unlikely the patient ha[d] an MI’ it sufficed to tell the admitting physician about the patient so he would receive appropriate follow-up care for his condition in the hospital. As stated more abstractly in the above Excerpts, this example case suggests that exact diagnosis is *not* the primary goal pursued in the ED. Instead, ED physicians are trying to ascertain the acuteness and severity of medical problems and then decide what kind of follow-up the patient requires and where in the health care system s/he can receive adequate care. In other words, once a patient is admitted (‘he is staying anyway’), the responsibility for further evaluation and diagnosis shifts to the admitting physician, which the Attending physician in Case 1 used to delimit the problem to be addressed and reduce workload in the ED. The next Case provides a description of a care delivery situation with a patient who is clearly ‘not sick.’

Case 2

A Resident goes to see an 18 year old patient who was knocking on a glass window, which shattered and lacerated the patient's pinky. The patient thinks there may be some glass stuck under the skin, the pinky feels numb. The laceration is closed already so the Resident suggests taking an x-ray and opening it up again if necessary.

Resident: She has a laceration on her pinky

Attending: Which hand was it?

Resident: The right one, the patient thinks there may be some glass stuck underneath so we should get an x-ray of her hand. Her Tetanus is up to date.

Attending: Ok.

The x-rays came back but did not provide a good picture of the laceration site.

Resident: [to the Attending] Are you ok with this x-ray or do you want me to do a formal study and redo the x-ray ... I feel ok with it.

Attending: Ok.

Resident: She is *a little numb* around it.

Attending: [a little irritated and in an ironic tone] *What do you want to do about it? Call surgery?*

Resident: Maybe get an aluminum splint.

Attending: *The only thing I would do: Give her a number for hand surgery if the pain persists.*

Case 2 is an example of a non-urgent care patient where the disposition decision to admit versus discharge the patient was trivial and could be ruled out from the start. Specifically, the patient in this case came in with an already closed laceration on her pinky. Given inconclusive evidence based on the x-rays, the Resident mentioned a concern that the area around the laceration 'is a little numb.' The Attending's reaction – 'What do you want to do about it? Call surgery?' – suggested that obviously, this patient was not going to stay in the hospital for further, elaborate treatment. Instead of ordering

additional tests in the hospital to ascertain the patient's problem (i.e., diagnose), the patient could be discharged with 'a [phone] number for hand surgery if the pain persists.'

In other words, once an acute health threat is ruled out, the ED physicians' primary task – to decide whether the patient is 'sick' or 'not sick' and warrants admission versus discharge with follow-up – is terminated. The patient's pre-evaluated problem now belongs to the specialist or primary care physician who can provide the patient with adequate follow-up. In other words, by framing the problem to be solved around whether the patient is 'sick' versus 'not sick,' ED physicians can reduce the need for deliberation and delimit the range of evaluation strategies they consider when dealing with the complexity and uncertainty inherent in emergent medical problems. The next section will describe the strategies ED physicians used during the observations to categorize their patients into 'sick' versus 'not sick' patients: The 'worst case' and the 'common-things-are-common' heuristic.

Safe but (sometimes) inefficient: The 'worst case' heuristic

Excerpt 3:

We practice 'worst case' thinking ... if we cannot find a bad thing and we don't have a diagnosis [the exact etiology of the patient's complaint is unclear] we send [the patients] home with follow up.

Excerpt 3 of a conversation between an attending ED physician and the observer provides a succinct definition of the 'worst case' heuristic. First, the statement '*We practice 'worst case' thinking*' suggests that the 'worst case' heuristic is a commonly used and formally accepted method in the ED (cf. Livingston, 1987). Second, this heuristic is optimized for and aims to '*find a bad thing*.' Third, once bad things are ruled out and no medical problem can be identified to categorize the patient as 'sick' ('if we

cannot find a bad thing and we don't have a diagnosis'), care delivery in the ED is terminated ('we send [the patients] home with follow up'). Thus, the 'worst case' heuristic differentiates 'sick' versus 'not sick' patients by ruling out (often unlikely) lethal emergencies, which require immediate attention by a medical professional. This suggests that, in the ED, bad things or to-be-ruled-out 'worst cases' are defined with respect to both the extent and immediacy of a medical threat (see Figure 2). Qualitatively, Figure 2 shows that 'worst cases' (all cases above and to the right of the dashed line) are both severe and acute in that they require immediate medical attention.

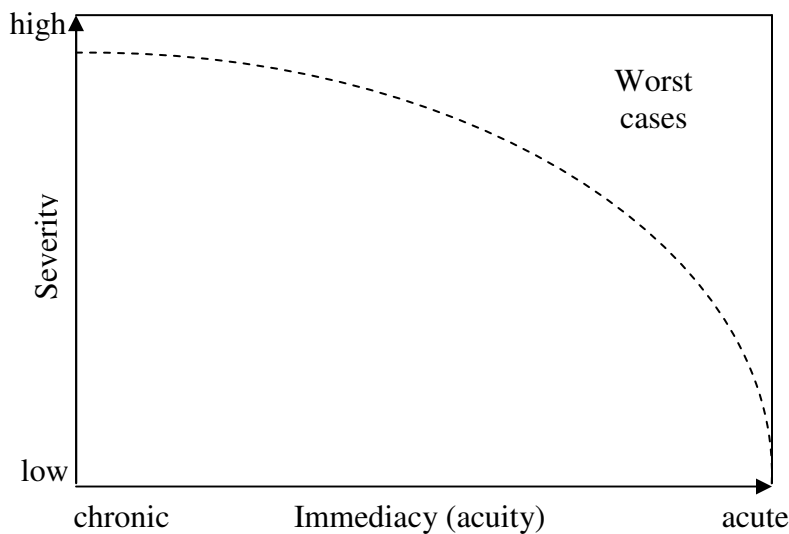


Figure 2. Qualitative definition of 'worst cases' as a function of the severity and immediacy (acuity) of medical problems.

To summarize and formalize the above discussion, there are three main components or building blocks to the 'worst case' heuristic: A *search rule* (i.e., physicians 'practice 'worst case' thinking' to 'find a bad thing' with respect to the patient's symptoms); a *stopping rule* (i.e., physicians either can or 'cannot find a bad thing'); and a *decision rule* (i.e., physicians keep the patient in the hospital or 'if [they] cannot find a bad thing and ... don't have a diagnosis ... send them home with follow-

up'). The following Cases will provide prototypical examples demonstrating 'worst case' thinking in ED physicians and its ecological rationality for the practice of emergency medicine in the U.S. health care system.

Case 3

A Resident goes to see a 45 year old male patient who came in by ambulance with a syncope episode. The Resident is informed by the nurse that the patient had a heart catheterization the previous day and that he is also 'very nervous.' The cardiologist identified no sign of stenosis¹⁰ during the catheterization lab¹¹. Earlier that day, the patient woke up on the kitchen floor. He thinks he was probably standing before he lost consciousness and probably had a 'panic attack.' At this time, the patient complains of 'a little' chest pain and heart palpitations. The patient is diabetic; his blood sugar values checked 182 initially, and 245 after a second measurement. In the following, the Resident and an Attending discuss this patient's case.

Resident: The patient in 19 is a diabetic on an insulin pump. He had heart symptoms so he had a heart cath[eterization] yesterday, but his heart was apparently pristine.

Attending: Great.

Resident: No loss of bowel or bladder; no focal weakness or previous seizure disorder; no boney injuries as far as I can tell right now. His c-collar is still on but I think we can take it off if he is not tender.

Attending: I would CT his head... and call the cardiologist to explain what happened.

Resident: The EKG is ok. *I don't think we need enzymes because he just had a cath yesterday.*

Attending: So why did he pass out? Maybe he had a hypotensive episode? *Just do the heart for me to be on the safe side*, get his electrolytes, BMP¹², CBC¹³, cardiac panels, and a head scan.

Resident: Do you want to spin his neck?

Attending: No, but *I wonder about his heart...* after the cath and all.

The ultrasound (US) technician comes by to report on an ultrasound exam the Attending had ordered while he was talking with the patient.

US tech: *He has a DVT* [Deep venous thrombosis]¹⁴.

Attending: That would explain why he passed out. Let's spin his chest [] Maybe he knocked off a little piece of the clot.

Resident: *Interesting ... he is not tachy[cardic] or sats low*¹⁵.

Attending: Yeah, I know.

Later when charting for this patient.

Resident: What's the right formulation for this?

Attending: Right ileac ephemeral DVT. They gave him blood thinners when he had the cath. I thought he might have a little dissection and hoped they would see it on the ultrasound but they found this other *unexpected finding* [the DVT] ... so it was a real syncope, not just lightheadedness.

The 'worst case' search rule. Case 3 demonstrates an important and immediate payoff associated with 'worst case' thinking. The search for 'bad things' is instrumental in helping ED physicians save patients' lives by detecting 'unexpected findings' (i.e., medical emergencies such as a DVT) even in the absence of signs and symptoms that are usually associated with this kind of medical problem (i.e., 'he is not tachy or sats low'). Specifically, the Attending physician in Case 3 indirectly mentioned two 'worst cases': Cardiac problems and an arterial dissection (i.e., 'Just do the heart for me to be on the safe side' and 'I thought he might have a little dissection'). By following adequate procedures to rule out these concerns, the ED team practically 'stumbled upon' a third 'worst case,' a DVT in the right ileac vein, which could then be addressed appropriately. This suggests that following 'worst case' clinical algorithms and ordering appropriate tests does not only help physicians rule out a list of potential life threats with respect to particular symptoms but it may reveal other, hitherto unexpected medical problems (e.g., another life-threatening condition such as a DVT)¹⁶. In other words, 'worst case' thinking

provides ED physicians with a potent first hypothesis to guide the evaluation process and identify medical emergencies. The following Case 4 will provide an example of a second major benefit associated with the search for ‘worst cases.’

Case 4

A Resident goes to see a 47 year old female patient. While walking to the patient’s room the Resident comments on the patient’s numerous complaints: “What did she come here for? She has so many things.”

During the interview, the patient complains of a headache, which is persistent since she took nitro glycerin for chest pain she had experienced three days earlier. The patient took Tylenol and Nyquil, which gave her diarrhea. She is also complaining of chills and sweats and pressure on the left ear. Finally, the patient complains of a bloody cough since the day before. The patient is a smoker.

While walking back to the physicians’ station, the Resident to the observer:

Resident: This patient has so many complaints. I just focus on one. *You have to tradeoff what’s important to me [as an ED physician] and to them ... I try to focus on one thing.*

The Resident reports to the Attending:

Resident: She has lots of problems, some viral symptoms, no chest pain, no previous MI.

Attending: Why did she take nitro?

Resident: She had chest pain at the time.

Attending: [pointing on the patient’s chart] *Here is what I don’t like* [the patient’s heart rate is 117]

Resident: She is very hyper right now, jumping all over so I give her fluids and Toradol¹⁷?

Attending: *She is 47 years old, she is a woman, not hypertensive but tachy[cardic]. She has a better chance of being discharged if we do it all.*

Resident: Ok.

The Resident orders a CAT scan of the head; Basic Metabolic Panel (BMP); Complete Blood Count (CBC); an EKG; cardiac monitor¹⁸; PT/PTT¹⁹; cardiac enzymes²⁰, a chest x-ray;

Influenza A&B screen²¹; normal saline (1,500ml); and Morphine. The patient is eventually discharged with a diagnosis of pneumonia and headache.

Case 4 shows that the search for ‘worst cases’ helps ED physicians structure and constrain the evaluation process. Specifically, the patient in Case 4 came in with an overwhelming number of complaints and the Resident (correctly) recognized that ‘you have to tradeoff what’s important to me and to them’ and just ‘focus on one thing.’ The Attending further qualified this statement suggesting that the ‘worst case’ search strategy does not only help ED physicians to ‘focus on one thing’ but to identify ‘what I don’t like,’ which is the most pressing concern (here cardiac problems) for a particular patient (‘She is 47 years old, she is a woman, not hypertensive but tachy’). Once identified, these concerns for ‘worst cases’ can be effectively ruled out by selecting the appropriate clinical algorithm. This simplifying feature makes the ‘worst case’ search rule an effective strategy to reduce the number of different ways a given medical problem, let alone a whole list of complaints, could be reduced to a more manageable number of strategies. Specifically, in Case 4 ‘worst case’ thinking reduced the patient’s list of complaints (i.e., headache; chest pain 3 days ago; diarrhea; chills and sweats; pressure on left ear; and bloody cough) to two major concerns: Cardiac problems because of the chest pain (the Attending requested cardiac tests), and a head bleed because of the patient’s persistent headache (the Resident ordered a cat scan of the head).

The relationship between the selected evaluation strategy (i.e., check for cardiac issues, PE, and a head bleed) and the care delivery outcome (i.e., the patient got discharged with a diagnosis of pneumonia and headache) suggests a side effect of the ‘worst case’ search rule. Although the ‘worst case’ search rule effectively rules out life threats, Case 4 has shown that it incurs intensive testing for severe but often unlikely

diseases. Whereas the patient's medical problem (i.e., pneumonia) could have been identified by ordering a chest x-ray and testing for bacterial infections, 'worst case' thinking led the physicians to order elaborate tests and 'do it all' before dispositioning the patient. This points to a major limitation of the 'worst case' search rule with respect to the efficiency of evaluation processes, which will be further discussed later in this section.

The 'worst case' stopping and decision rules. Once a medical problem, which requires immediate medical attention, is identified (the upper right corner labeled 'worst cases' in Figure 2), ED physicians will provide stabilizing treatment and admit the patient to the Intensive Care Unit (ICU) or to the adequate specialty unit such as neurology (i.e., the stroke team) or cardiology (i.e., the catheterization lab²²). If the 'worst case' algorithm does not reveal medical emergencies (everything that does not fall within the bounds of 'worst cases' in Figure 2), the evaluation in the ED is technically terminated (the stopping rule). The physician will then decide whether to admit or discharge the patient based on the severity of the medical problem (the decision rule). A specific example of the 'worst case' stopping rule has already been given by Case 4. The Attending physician in this case description suggested that the patient with multiple complaints 'has a better chance of being discharged if we do it all.' That is, the Attending physician in Case 4 suggested that to effectively categorize the patient as 'sick' (needs to be admitted) versus 'not sick' (can be discharged with follow up) all potential 'worst cases' have to be ruled out. See the following Case 5 and Case 6 for examples of how the 'worst case' heuristic is commonly used to justify the termination of the emergency care process and disposition (i.e., admit or discharge) a patient.

Case 5

An attending goes to see a 77 year old female patient who had fallen twice earlier that day (around 10:30am) when she felt something ‘burst in my head’ and perceived a lot of noise to be emanating inside her head. She was scheduled for an MRI the same day because of a nodule on her neck, near the carotid artery. Her family physician had sent her to the ED to ‘get checked out’ before undergoing the MRI procedure. The patient seems slightly confused and slow in responding to questions. The patient’s daughter states that the memory loss and confusion is not normal for her mother. Thus, the Attending was concerned about a transient ischemic attack (TIA²³) as a potential cause of the patient’s fall and confusion as well as a head bleed due to the fall. The work-up consisted of basic screening labs (i.e., BMP, CBC) as well as a cat scan of the head.

The test results are back and the Attending informs the patient and her daughter about the findings.

Attending: All basic labs have been done and they are back normal. The CAT scan is showing no bleed but it’s not 100% correct; 3-5% of all actual bleeds are not detected with a cat scan. The only way to be 100% sure is to do a spinal tap²⁴.

Daughter: That’s not a good option. What are the symptoms of a head bleed?

Attending: Normal symptoms are severe headaches, mostly in the back of the head, confusion, sleepiness, stroke-like symptoms. But her neuro test was normal. One part of her history looks like ‘Aneurism,’ the other part of her present history doesn’t sound like it at all. The text book says: Spinal tap. If you ask me what I think? Is that caused by an aneurism? No. But the lawyers and medical experts tell me to do it anyway. I can’t prove it 100% in any other way. I will be honest with you: It’s not easy in a 77 year old patient.

Daughter: Yeah, and she has osteoporosis and degenerative disc disease. What test shows a TIA?

Attending: TIA is a clinical diagnosis. No clinical test shows that. It’s basically a warning shot that something needs to be done. In the worst case a little leak doesn’t show on the CT, the blood vessel bursts at home and she dies within minutes.

Daughter: What else can we do? What else can cause it?

Attending: Many things. *But we only look at the bad things here...* I will call your PCP and see what he says but I don't think he will add much to this.

Daughter: She saw her PCP a couple of days ago.

Attending: I suggest getting her admitted for observation [to internal medicine] and they can consult with neurosurgery if they think that's necessary. *She is sitting on the fence, definitely.* Do you have anything against keeping her here?

Daughter: It's up to her [looking at her mother].

Patient: [looking at her daughter]. If you think that is best for me.

This conversation between Attending physician and the patient's daughter

illustrates several points about the 'worst case' stopping and decision rule. First, the Attending used the 'worst case' search rule to check for immediate life threats and once ruled out, responded to the question of 'what else can be done' by stating that 'we only look at the bad things here.' Thus, the Attending used the fact that no 'worst case' could be identified as a simple stopping rule, which justified the termination of care delivery in the ED.

Second, although the CAT scan ruled out immediate life threats such as a major head bleed, it neither effectively ruled out a (minor) TIA nor did it provide information as to what other processes might be underlying the patient's persisting complaints (i.e., no exact diagnosis). That is, the patient's ambiguous state of health could not be resolved by applying the 'worst case' search rule. Instead, the 'worst case' search rule transformed the patient's problem from an emergent 'worst case' to a potentially dangerous problem that requires caution but not immediate medical attention. Thus, because the patient was 'sitting on the fence,' the Attending decided to admit the patient to the hospital where a more in-depth analysis could be performed, including consultation with a neurosurgical specialist.

Finally, by admitting the patient to the hospital, the Attending was able to circumvent legal requirements underlying the ‘worst case’ approach (i.e., ‘Is that caused by an aneurism? No. But the lawyers and medical experts tell me to do [a spinal tap] anyway’). If the patient had not consented to staying in the hospital, it is likely that the physician would have insisted on the spinal tap or at least, would have made sure the patient left the hospital with an appointment at a neurosurgeon’s office and received appropriate follow-up care. Case 6 provides an example of the same Attending physician modifying the ‘worst case’ decision rule to disposition a chest pain patient who was ‘sitting on the fence’ but did not want to stay in the hospital.

Case 6

An Attending goes to see a 44 year old female patient with recurrent chest tightness (‘It felt like 50 pounds of potatoes on my chest’). The patient also complains of a sharp feeling through her left shoulder and fingers with numbness in her left ring finger and pinky. The pain lasted for about 2-3 minutes and did not recur since the event earlier that day. The Patient had a heart catheterization in the previous year at the same hospital. At that time, she had been prescribed nitro glycerin for chest pain but never took any (‘I threw them away’). The patient is a smoker.

Attending: Your EKG looks fine but that’s not everything ... 3-5 out of 100 patients with a cardiac problem actually have a normal EKG. When did it start?

Patient: Around 11 [pm].

Attending: Ok, there are 3 things we can do: 1. I can give you meds for the heaviness feeling; 2. we can order a couple of tests; 3. I will check your history to see what your tests at [the other hospital] showed.

Patient: My blood pressure is high [153/85] why is it that high?

Attending: That’s normal, you have chest pain and you are in the ED. That usually makes the blood pressure go up.

The Attending orders a chest x-ray, a cardiac panel including blood coagulation tests, an

EKG, cardiac enzymes, and a d-dimer [a screening test for blood clots].

The Attending goes to tell the patient that all tests came back negative.

Attending: I couldn't find anything with the tests, your chest x-ray looks fine, your enzymes are fine and they should show if you had problems with your heart a couple of hours ago. But I want to keep you here over night.

Patient: What do they want to do?

Attending: Probably a stress test [of the patient's heart].

Patient: Naa ... I want to go home.

Attending: We should do at least one more blood test [if a second set of cardiac enzymes shows no changes compared to the first set, a previous injury to the patient's heart can be ruled out]. You can go home after the blood test comes back negative and after I call the clinic for a follow up appointment tomorrow.

Just like the previous example, Case 6 shows that the 'worst case' decision or better, disposition rule is marked by a cautious attitude. The (same) Attending physician 'couldn't find anything with the tests' in both examples. Although immediate life threats had been ruled out, the physician remained suspicious about less acute but lingering disease processes (in Case 5 the patient's symptoms persisted and in Case 6 the patient had a previous history of cardiac complications). Thus, in both cases it was safe to suggest keeping the patients 'here over night.' Because the patient in Case 6 did not want to stay in the hospital, the Attending physician satisfied precautions by running additional tests and arranging a follow-up appointment for the next day. The 'worst case' decision rule is epitomized by the following statement, which is taken from a conversation between an Attending physician and the observer.

Excerpt 4:

Attending: The rule of thumb for residents is: *You can't go wrong with admitting someone. You sort it out later.* That's what happened when I was working at Miami Valley Hospital. Sometimes I didn't even have time to see a patient. When I got around checking on them the Resident had already admitted them and they were upstairs.

Excerpt 4 suggests that ED physicians in general have a low admission threshold because 'you can't go wrong with admitting someone.' In other words, if after having ruled out 'worst cases,' ED physicians are still in doubt about the patient's state of health it is the safe choice to admit the patient to the hospital. There s/he will receive continuous medical attention by the appropriate specialists who can 'sort it out' and intervene if necessary. Thus, on one hand, a low admission threshold is as an efficient way to reduce workload while maintaining high safety standards. This is particularly relevant for ED physicians in the U.S. health care system who have to make medical decisions under strict legal regulations (Bitterman, 2001), pervasive time pressure (e.g., Croskerry, 2002), and increasing patient loads (IOM, 2006). On the other hand, the examples show that a cautious attitude creates additional work elsewhere in the hospital (e.g., for the admitting physician as in Case 5)²⁵, and potentially even for the ED physician (e.g., a patient does not want to be admitted and instead requires further testing and follow-up appointments as in Case 6). The next section will further elaborate on the observed limitations of the 'worst case' heuristic.

Limitations of the 'worst case' heuristic. Just like every boundedly rational decision strategy, the 'worst case' heuristic is not effective in all situations. That is, in certain environmental settings the 'worst case' heuristic, as noted above, can result in inefficient use of resources. In other situations, it may be underspecified leaving 'open

constraints' in the problem definition ('definitional slack') thus, failing to lead to a satisfying solution. This may require problem restructuring and deliberation about effective courses of action on the part of the physician and/or the patient (cf. Reitman, 1964; Shalin & Bertram, 1996; Simon, 1973). In the following, examples will be provided of situations where the 'worst case' heuristic leads to suboptimal outcomes. The first example is representative of some of the definitional problems ED physicians encountered during observations when trying to apply the 'worst case' heuristic.

Case 7

3:20 pm

A Resident and Attending go to see a hospice (end stage dementia) patient who was brought in for breathing problems. The patient's blood oxygen saturation is at 100% but the patient is breathing heavily and is very agitated. The Resident orders 1mg of Morphine 'to reduce her air hunger and calm her down' and a chest x-ray. The Attending, also in the room with the patient, orders a breathing treatment. At 3:45 pm, the physicians return from the patient's room.

Attending: [to the Resident] *make sure it's not just Urosepsis*²⁶. [the Attending checks the patient's history]

Resident: So get her urine and get her ABGs [arterial blood gas values], too? She may be eligible for BIPAP [a particular form of non-invasive ventilation]²⁷.

Attending: The patient has a history of CVA [Cerebral Vascular Accident] and an aneurism; She got Ativan²⁸ before for agitation. Hold off with any other meds before we know more. She is not hypoxic ... maybe it's just her nerves ... she is on Ativan [for Parkinson]. She lives in a nursing home and is DNR-CC²⁹.

Are you doing blood cultures in case she had pneumonia?

Resident: [after adding blood cultures on the order sheet] And .5 mg of Ativan?

Attending: Sure, that's fine.

Resident: [there is a note in the patient's chart] What's the insurance issue with respect to admission for this patient?

Attending: I don't know. I think if a patient is in the hospice for a specific problem, they should not be admitted for that problem to the hospital.

Resident: *Should we still get a CT* [to check for pulmonary emboli (PE) that may cause her severe shortness of breath]?

Attending: Hmm, that's interesting. We will need her BMP back, *if there is another reason* [for her shortness of breath] *we may not look for PE... does it make sense to look?* Let's get a better feel and look at her labs.

4:08pm

The patient's family arrives.

Patient's son: They sent her here [from the nursing home] because she had some kind of seizure. Her breathing was fine at the nursing home. She couldn't lift her arm and her head was shaking. She was 98 O₂ [her blood was saturated with oxygen to 98%].

Resident: It's 94 now. The seizure doesn't really fit in the picture. *We have a concern for PE, a clot in her lung.*

4:15 pm

After talking to the patient's son and his wife, the Resident reports to the Attending back at the physicians' station.

Resident: She has no COPD history. She had pneumonia recently and got antibiotics for it [the type of antibiotics is unknown]. The family confirmed the DNR. They were saying that she might have had a seizure ... but she could communicate at the time so a seizure is unlikely. She satted at 98 [her blood was saturated with oxygen to 98%], after 20 minutes they called the EMS. She was at 69% when she came in *so it all looks like a PE.*

Attending: *Absolutely.*

After looking at the patient's EKG, the Resident and Attending check the patient's chest x-ray.

Resident: Looks odd, looks like her stomach is up in her chest.

Attending: She has a big hiatal hernia³⁰.

Resident: It's humongous [approximately 2/3 of the patient's lung is occupied by the hernia] Should we scan her today?

Attending: That's fine... if her creatinine is high still, scan her but without contrast.

5:40 pm

The Resident is still waiting for the patient's creatinine value to come back. The patient's white blood count (WBC³¹) is 25.8 indicating an infection.

Attending: She *probably* doesn't have a PE, it's the hernia. Talk it over with the consultant. He is gonna want to admit her.

Resident: *The family wants her cleared only.*

Attending: She is septic. Talk to her family. If they say she should go back to the nursing home but they might not take her; they can do only certain things ... then she needs to go to the hospital. *She meets 3 out of 3 admission criteria for COPD.*

Later, the family requested that the patient be transported back to the nursing home.

Case 7 is an example where the 'worst case' search rule under-specifies a clear evaluation strategy. Specifically, the terminally ill (hospice) patient came in with acute shortness of breath. However, instead of evaluating the patient for 'worst cases,' the Attending, after ordering stabilizing treatments, asked the Resident to rule out a simple disease, which could explain the patient's problem ('Make sure it's not just urospesis'). More importantly, even though the 'worst case' of a pulmonary embolism (PE) was part of the physicians' differential diagnosis ('we have a concern for PE'), the patient's 'Do-Not-Resuscitate: Comfort Care' (DNR-CC) status increased the ambiguity about the appropriate evaluation strategy for this patient. Whereas the Resident asked 'should we still get a CT,' the Attending suggested that 'if there is another reason [for the patient's shortness of breath] we may not look for PE.' Moreover, the Attending was unsure about whether it made sense to look for a PE at all. After the finding of a hiatal hernia on the

patient's chest x-ray, an attempt was made to order a CAT scan of the patient's chest to rule out a potential PE. However, this order was never executed because the patient 'probably' did not have a PE and was likely going to be admitted to the hospital (i.e., a test for PE could be saved because the patient could be categorized as 'sick'). Finally, with respect to the 'worst case' decision (disposition) rule even though the patient met '3 out of 3 admission criteria for COPD,' the patient was transported back to the nursing home by request of the family.

This example shows that 'worst case' search, stopping, and decision rules do not – at least, in the case of severely ill patients – provide unequivocal guidelines of where to start the evaluation process, when to end, and what to do once evaluation is successfully terminated. Instead, Case 7 points to physicians' need to fine-tune their evaluation and treatment plans (cf. Shalin & Bertram, 1996) as well as their disposition decisions based on the particular needs and circumstances of the patient including questions concerning the quality of life in terminally ill patients as well as family preferences (cf. Hardwig, 1990).

Example Case 1 described at the beginning of this section about a patient with a lacerated pinky involved the same Attending and Resident physician (i.e., the same shift) as Case 7. Unlike Case 7, which described the case of a terminally ill patient, Case 1 provided an example of a non-urgent care patient where the Attending physician abandons the 'worst case' search rule because the patient was clearly 'not sick' and did not require elaborate testing in the ED. This suggests that fine-tuning and adaptation of the formally accepted 'worst case' evaluation rule is not only an issue for the severely ill but also for patients with minor medical problems. To effectively treat minor medical

problems such as a lacerated pinky, ED physicians' may need to overwrite an overly restrictive definition of the 'worst case' heuristic by presuming that the patient is 'not sick' and therefore can be discharged without further testing.

As stated above, the 'worst case' heuristic is an effective strategy to identify medical emergencies. However, examples have shown that the 'worst case' search, stopping, and decision rules are underspecified in some cases (e.g., a DNR-CC patient with shortness of breath as in Case 7) and overly restrictive in others (e.g., a patient with a lacerated pinky as in Case 1). In these situations it is up to the ED physician to select search, stopping, and decision rules that adequately address the patient's complaint. The next examples describe some of the consequences that result when physicians use the 'worst case' heuristic indiscriminately without considering situational demands or more generally, the context in which it is applied.

Excerpt 5:

Attending 1 and 2 talk with a Resident about the inefficiencies and medical dangers associated with ordering too many medical tests.

Attending 1: It's my 5th year here and *I way backed off* [with ordering tests]

Attending 2: Yeah me, too!

Attending 1: You will find that we [Attending 1 and 2] practice both very similarly but then there is Dr. M. He admits everybody and puts them through the scanner.

Attending 2: He will tell you he does the same every time.

Resident: That's good, it's good predictability.

Attending 1: He will encounter reality at one point. *You cannot keep doing this all the time; I just do BMP, CBC, and a UA [urinalysis] for all kidneys, that's it.* Some of the 3rd years [residents] still want to scan everybody, even if the patient got 24 kidney scans before: NO!

Attending 2: If I can kind of guess what it is [then the a CAT scan may not be necessary]
sometimes you can guess what it is, right?

Attending 1: I want the patient to make an informed decision: Do you want the radiation? I
can give it to you.

Attending 2: Yes and *deal with your colon cancer later*.

Attending 1: Some patients really want to know where it is and how big it is ... so they get
the radiation.

Excerpt 5 suggests that in an extreme form ('He admits everybody and puts them through the scanner') strict adherence to the 'worst case' search rule may provide 'good predictability' but is inefficient ('you cannot keep doing this all the time'). From a conceptual perspective, by strictly adhering to the 'worst case' heuristic, physicians may trade off medical (and legal) safety with the extensive and (potentially) inefficient use of resources such as time, medical technology, and lab capacities. In addition, overuse of medical technology and testing may potentially be detrimental and even harm the patient's health ('deal with your colon cancer later'), ultimately violating the principle of 'first do no harm.' Instead, with experience ('sometimes you can guess what it is') the attending physicians in this example resorted to simpler and less aggressive, but sufficiently safe evaluation strategies to differentiate 'sick' patients from those who are 'not sick' ('I way backed off ... I just do BMP, CBC, and a UA for all kidneys, that's it').

Thus, to delivery emergency care efficiently, ED physicians can and must identify situations when it is medically and legally safe to effectively shortcut the full-blown, ideal procedures implied by the 'worst case' algorithms. Instead, they may use lesser procedures, which may not yield optimal predictability with respect to a specific 'worst case' but may be 'good enough' to identify a 'sick' patient safely and reliably. In other words, there are other strategies, apart from the formally accepted 'worst case' heuristic,

that help ED physicians satisfice with respect to their fundamental task, the categorization of patients into ‘sick’ versus ‘not sick.’

Another potential problem with the ‘worst case’ heuristic is that the work-up and search for ‘worst cases’ itself may change the setting of the stopping rule and/or require physicians to make decisions, which are unwarranted or even undesirable for a particular patient. See Case 1 and Excerpt 6 for examples suggesting that certain test orders and results may, based on ‘worst case’ thinking, require unnecessary procedures and/or incur additional testing and work for the physician.

Excerpt 6

After reporting to an Attending physician about an 80 year old patient with a major complaint of shortness of breath and a history of chronic obstructive pulmonary disorder (COPD) the Resident turns to the observer:

Resident: [to the observer] *They say there is no harm in ordering a test. It’s not the test but the information you get and need to act on.* In this case: COPD can elevate enzymes³², which may necessitate a cardiac cath. Instead he is admitted for pulmonary disease which requires a lesser procedure.

By stating that ‘It’s not the test but the information you get and need to act on’ the Resident suggests that results of medical tests may delay the termination of the care delivery process (i.e., delay the stopping point of the ‘worst case’ heuristic) and/or incur the need for additional procedures, which may be unwarranted given a patient’s particular circumstances (e.g., a heart catheterization instead of admission for pulmonary disease). Although this feature of the ‘worst case’ heuristic may be desirable in cases where preliminary tests point to more severe underlying pathology (e.g., some ‘worst case’), in other cases additional testing may lead in medically unproductive directions and/or result in inefficient use of resources.

The ecological (ir)rationality of the ‘worst case’ heuristic. Public health specialists have recognized that care providers in the U.S. health care system emphasize (and their patients expect) specialized, mostly technology-based treatment of esoteric diseases over the delivery of population-wide primary care (Shi & Singh, 2008). A similar bias is reflected in ED physicians’ use of medical technology to search for the often unlikely ‘worst case’ compared to the more common benign problems that may be associated with a specific symptom combination. In addition to a culturally-based emphasis on the treatment of medical ‘worst cases,’ emergency medicine in the U.S. is practiced in a strong legal environment, which is marked by a pervasive threat of malpractice litigation (e.g., Bitterman, 2001; Shi & Singh, 2008). Therefore, it is reasonable for ED physicians to maintain a cautious attitude when evaluating their patients and interpreting test results. The ‘worst case’ heuristic is ED physicians’ accepted method to cope with these sociocultural and legal constraints.

In particular, the ‘worst case’ heuristic helps ED physician constrain the search space of possible medical etiologies to life threatening diseases, which puts a definite and medically as well as legally acceptable stopping point to the care delivery process in the ED. To do so, ED physicians take advantage of the norms associated with inductive inference (Platt, 1964). That is, the goal of their ‘worst case’ thinking is not to *prove* or *verify* a particular hypothesis (e.g., to identify the likely diagnosis) but to simply *rule out* competing hypotheses (i.e., life-threatening issues versus benign problems). Thus, by making their priority to rule out life threats, ED physicians exploit the benefits of inductive logic and selective hypothesis testing to simplify the diagnostic process (cf. Sanbonmatsu, Posavac, Kardes, & Mantel, 1998). In other words, a physician who uses

the ‘worst case’ search rule does not need to (and, given the time constraints in the ED may often not be able to) identify a precise medical diagnosis. Instead, the ED physician can use the search for ‘worst cases’ as a safe (i.e., ‘good enough’) working hypothesis, which eventually helps physicians provide appropriate stabilizing treatments, sort patients into categories of ‘sick’ (i.e., to-be-admitted patients) versus ‘not sick’ (i.e., to-be-discharged patients) and narrow down which medical specialty (e.g., internal medicine, cardiology, or neurosurgery) may be suited to provide the best follow-up care to the patient. In this sense, the ‘worst case’ heuristic on one hand and the constraints of the ED domain on the other are two blades of a scissors (cf. Simon, 1990), which cuts through the complexity and ambiguity inherent in the practice of emergency medicine in the U.S. by providing a safe and workable guide to action.

However, examples have shown that there are also limitations to the ‘worst case’ heuristic. Specifically, in situations where the ‘worst case’ search, stopping, and decision rules are underspecified with respect to a patient’s medical problem (e.g., Case 8) or overly restrictive (e.g., Case 1), indiscriminate use of this heuristic may result in an inefficient use of resources or worse, psychological and even physical harm to the patient. From a control theoretic perspective, the ‘worst case’ heuristic can be interpreted as a control mechanism with high gain (i.e., high sensitivity). Such a mechanism is highly responsive to changes in the controlled signal (i.e., the information provided) and very likely detects minor changes that may point to the presence of an unlikely medical emergency. In this case, the ‘worst case’ heuristic saves peoples’ lives. On the other hand, reliance on highly sensitive medical technology, and testing procedures may result in inefficiencies if the situation does not warrant ‘worst case’ thinking.

Conceptually, a high-gain control mechanism amplifies not only the signal but also the noise in the provided information and therefore results in an increased number of false positives. That is, a control strategy, which is highly sensitive to signs of ‘bad things,’ is likely to identify ‘worst cases’ where there are none and result in additional test orders and/or preventative admissions for patients who actually suffer from benign diseases. For example, there is evidence that only 25% of those patients who were admitted to the coronary care unit at a midsize rural hospital in Michigan actually did have a ‘worst case’ such as a myocardial infarction (Green & Mehr, 1997; Green & Smith, 1998). In an extreme form, an overly cautious attitude may result in the practice of ‘defensive medicine’ where tests are ordered and patients are admitted not because it is medically necessary but because it is ‘safe’ from a legal perspective (cf. Studdert et al., 2005).

In summary, observational data suggested that the ‘worst case’ heuristic is ED physicians’ ecologically rational response to the sociocultural and legal constraints in the U.S. health care system and a well adapted, accepted method to identify medical emergencies and ultimately, save peoples’ lives³³. However, further findings indicated that the ‘worst case’ heuristic, in an unabated form, trades off safe with efficient medical care. Specifically, the ‘worst case’ heuristic emphasizes catching the rare ‘worst case’ versus identifying the most likely disease, which results in increasing numbers of false positives and ultimately, inefficient allocation of scarce medical resources. This is a major drawback of the ‘worst case’ heuristic, particularly given the steadily increasing patient volume in U.S. Eds (NCHS, 2007) and growing numbers of non-paying, uninsured ED patients (IOM, 2006). To reduce the number of false positives and

circumvent inefficiencies, control theory suggests the need of counter strategies that will lower the gain in order to achieve a system that achieves a more satisfactory balance between misses and false alarms. An observer (e.g., ED physician) using a low gain strategy will more effectively filter out unimportant, noisy information and will tend to focus on what is common and to be expected instead of what is unlikely but undesirable (for examples of how fast and frugal heuristics can decrease the number of false positives with respect to the admission of cardiac patients see Gigerenzer & Kurzenhäuser, 2005; Green & Mehr, 1997; Wegwarth et al., 2009).

Thus, despite the emphasis on medical safety in the U.S. emergency care system, sometimes deviations from the ‘worst case’ algorithms (e.g., lesser procedures and evaluation strategies) may be necessary to get work done effectively and safely. The next section will elaborate on some of the search, stopping, and decision rules ED physicians used during observations – that is, a second set of tools in their adaptive tool box – to account for the limitations of the ideal form of the ‘worst case’ heuristic.

Efficient but (more) risky: The ‘common-things-are-common’ heuristic

Excerpt 7:

Resident: This Attending thinks everybody gets admitted; then he tries to find a reason not to admit. Others go in and ask themselves: Admit or go? They try to find evidence to prove or disprove either decision. That’s just interesting to me, gives you different set points.

Excerpt 7 suggests two ‘different set points’ or strategic frameworks for the practice of emergency medicine. In the first framework ‘everybody gets admitted’ until a reason is found not to admit the patient. This framework reflects the general approach associated with the ‘worst case’ heuristic (a high-gain strategy) in that every patient

suffers from a ‘worst case’ until proven otherwise. The second framework is, just like the ‘worst case’ heuristic, based on a binary categorization of patients’ state of health with respect to their medical needs (i.e., ‘admit or go’ is defined in a sense similar to ‘sick’ versus ‘not sick’). However, whereas the ‘worst case’ heuristic is based on an inductive approach to rule out potential ‘worst cases’ and decide whether a patient should be admitted or can ‘go home,’ the second framework hypothesizes a patient’s disposition (i.e., state of health) and, based on this preliminary categorization (decision), tries to find evidence that helps ‘to prove or disprove either decision.’ That is, the categorization of patients with respect to ‘admit or go’ is not only the output of the care delivery process (as for the ‘worst case’ heuristic) but rather the input and basis for further evaluation of the patient. In other words, this second class of heuristics is based on a *deductive approach*, which helps ED physicians narrow down which search and evaluation processes are best suited to gather evidence in support of the patient’s hypothesized disposition and/or medical problem. From a pragmatic perspective, this framework is less stringent than the ‘worst case’ heuristic (a low-gain strategy) in that only ‘sick’ patients (i.e., those who likely have to be admitted) warrant the use of elaborate evaluation procedures to identify likely ‘worst cases.’ In this case, both ‘common-things-are-common’ and ‘worst case’ heuristic are isomorphic. Patients who are ‘not sick’ enough to be admitted (i.e., they can probably ‘go home’) likely do not suffer from a ‘worst case’ and therefore do not require elaborate evaluation procedures³⁴. Based on the hypothesis of a patient’s most likely medical problems, the deductive nature of the ‘common-things-are-common’ heuristic is likely to save medical resources by ignoring unlikely diseases (correct rejections). However, this also speaks to the major limitation of the ‘common-

things-are-common' heuristic. That is, by searching for and providing support for a hypothesized medical problem, this general heuristic cannot rule out potential alternative explanations and may therefore result in an increased number of 'misses' of additional, though unlikely, medical problems.

Conceptually, the 'worst case' heuristic is grounded in medical knowledge and statistical relationships between particular symptoms or complaints (cues) and potentially life threatening disease processes (outcomes). In other words, given a set of symptoms, the 'worst case' heuristic primarily aims to identify and searches for the most *lethal* (even though often unlikely) medical problems. On the other hand, fast and frugal heuristics hitherto identified in the literature use few pieces of information to predict the most *likely* outcomes based on probabilistic associations between environmental cues and a set of potential outcomes (for a general overview of such fast and frugal heuristics see Gigerenzer et al., 1999; for examples in the medical field see Gigerenzer & Kurzenhäuser, 2005; Green & Mehr, 1997; Wegwarth et al., 2009). In other words, these heuristics exploit the colloquial and experiential fact that 'common-things-are-common' most of the time. Based on above discussion, this second class of heuristics may increase care delivery efficiency and workload management; on one hand, by prioritizing ED care for patients who are 'sick' and likely have to be admitted and by allocating fewer resources to patients who are 'not sick' and can likely 'go' home on the other. See Case 9 for an example of how ED physicians used the 'common-things-are-common' heuristic during observations.

Case 9

A Resident goes to see a 71 year old female with a complaint of congestion and problems breathing. The patient is obese and has a red, sweaty face after coughing up mucus all morning. The patient is pain and fever free but chronically short of breath. During the physical exam:

Patient: I had one episode of coughing with consecutive chest pain.

Resident: Are you O²-ed at home [do you have an oxygen mask at home]?

Patient: No.

Resident: Did you ever have COPD [Chronic Obstructive Pulmonary Disorder]?

Patient: No.

Resident: Are you using steroids for shortness of breath?

Patient: No.

Resident: I will give you some Robitussin³⁵.

Patient: Maybe I have pneumonia... but I had chest pain.

Resident: Ok, we will get some blood work done and a chest x-ray... I'll also give you a breathing treatment. Are you diabetic?

Patient: Yes.

Back at the physicians' station the Resident and an Attending discuss the evaluation and treatment for this patient.

Resident: She had pain only once ... she is pain free now... but *with her risk factors, we should look at her heart.*

Attending: Still, *common things are common* ... do a mini work up; give her a breathing treatment; one set of [cardiac] enzymes is fine ... no repeat ... *if she has two to three days of acute sinus symptoms, it's not the heart.* Get a chest x-ray ... *if it's pneumonia, you can lock in her in that way.*

Case 9 is a representative example of an ED physician using a 'common-things-are-common' search rule. The patient described in Case 9 complained of 'one episode of coughing with consecutive chest pain,' was 71 years old, female, and chronically short of breath. Given her history of present illness (HPI) and demographic risk factors, the

Resident suggested to ‘look at her heart.’ However, the attending physician suggested to ‘do a mini work-up’ because ‘*common things are common.*’ That is, ‘if she has two to three days of acute sinus symptoms it’s not the heart’ indicating that the patient was likely ‘not sick’ and did not suffer from a cardiac problem.

One standard procedure ED physicians use to identify signs of extreme cardiac exertion (e.g., due to a heart attack) is to check the values of patients’ cardiac enzymes. Usually, elevated levels of cardiac enzymes can be detected 1-2 hours until 5 to 10 days after a cardiac event. Given that the patient had chest pain more than 2 hours ago, cardiac enzymes should have been elevated if the chest pain was related to the patient’s heart. Therefore, ‘one set of enzymes is fine’ to rule out the unlikely case of a cardiac problem. From a pragmatic perspective, based on the presentation of the patient it was apparent to the attending physician that ‘worst cases’ such as cardiac problems were unlikely and could be effectively ruled out without elaborated testing. In cases like this, ED physicians may be able to restructure and constrain a patient’s work-up to the search for and identify ‘common things.’ For example, the Attending in Case 9 suggested to ‘get a chest x-ray ... if it’s pneumonia [a common thing], you can lock her in that way.’

Conceptually, the attending physician used a simple medical test to rule out an unlikely alternative hypothesis (i.e., a cardiac ‘worst case’) before searching for evidence that would support a more likely and, in this case, benign explanation for the patient’s complaint (e.g., pneumonia). With respect to the ‘common-things-are-common’ heuristic, this example shows that the corresponding search rule is used to provide evidence in support of the hypothesis that a patient is ‘not sick’ without incurring elaborate testing. Once a reason for a patient’s problem is identified (the stopping rule), the patient can be

‘locked in’ and discharged with follow up (the decision rule). If the initial hypothesis cannot be supported with (laboratory) studies/tests, more elaborate procedures may be used to identify alternative explanations or the patient may be admitted for 23 hours of observations. In Case 9, the patient’s blood oxygenation value dropped to 92% so that the patient was ultimately admitted to the hospital for 23 hours of observation.

More generally, this representative example of the ‘common-things-are-common’ heuristic speaks to the essentially dynamic nature of emergency care delivery where evaluation and disposition decisions are dynamically adapted based on new information. Moreover, this example suggests that ED physicians may not use the unabated, general form of either the ‘worst case’ or ‘common-things-are-common’ heuristic. Instead, depending on the particular circumstances, they use a combination of both strategies to meet the demands at hand (e.g., ruling out alternative hypotheses and providing evidence for a more likely medical problem).

Limitations of the ‘common-things-are-common’ heuristic. Whereas the ‘worst case’ heuristic is safe but (sometimes) inefficient, the ‘common-things-are-common’ heuristic is efficient but (more) risky. Specifically, the ecological rationality of ‘common-things-are-common’ strategies depends on physicians’ ability to bring their categorization of patients and/or complaints in congruence with the actual state of the environment. The following excerpt of a conversation between an Attending ED physician and the observer is reflective of the major pitfall inherent in evaluation strategies that are based prior experience and the categorization of *individuals* with *particular* symptoms and complaints into classes of *likely* ‘sick’ versus *likely* ‘not sick’ patients.

Excerpt 8:

Attending: I once had a 21 year old patient who came in with chest pain. The patient went in and out with mental status change. I was thinking he was totally FAKING. But he ended up with a big bleed, an AD [aortic dissection] ... he had to be flown out to Cincinnati. They don't do that here.

Excerpt 8 describes a situation where an uncommon and unlikely combination of symptoms and patient demographics (e.g., a 21 year old chest pain patient with mental status change) points to a particular patient type with a fabricated complaint ('he was totally faking' and is therefore likely 'not sick'). However, complaints, which seem to be clear-cut, may be misleading and patients with an apparently non-medical agenda may end up being 'sick' with a life threatening condition (e.g., an aortic dissection). This example epitomizes the pitfalls inherent in low-gain evaluation strategies that are derived from categorizations of patients/complaints based on '*common*' or '*typical*' implications of specific clues or symptom combinations.

The ecological (ir)rationality of the 'common-things-are-common' heuristic.

Heuristic rules that are based on the fact that 'common-things-are-common' are successful most of the time because they are grounded in the statistical patterns that pertain to a task environment. For the ED domain, these rules are effective if what promises to be a common disease actually is a common disease and conversely, what seems to be an uncommon illness actually is uncommon (e.g., Gigerenzer et al., 1999). In situations where uncommon outcomes present in common disguise – for example, a patient with a heart attack may present with nausea and vomiting, which is typically related to stomach flu or food poisoning³⁶ – these heuristics can result in systematic

biases, suboptimal outcomes, and (potentially fatal) errors (e.g., Eddy, 1982; Kahneman, Slovic, & Tversky, 1982; Lichtenstein, Fischhoff, & Phillips, 1982; Tversky & Kahneman, 1973).

Satisficing in the ED: Balancing the safety-efficiency tradeoff

From a control theoretic perspective, the just described complementary relationship between ‘worst case’ and ‘common-things-are-common’ rules can be interpreted as the tuning of an optimal gain or sensitivity setting in the ‘ideal observer.’ As stated above, high-gain strategies such as the ‘worst case’ heuristic are highly responsive to change and deviations in the observed information (i.e., the signal). Whereas this control strategy likely detects the rare disease when it is present (i.e., it results in *many hits*), it amplifies irrelevant noise and results in *many false positives* (i.e., what is identified as ‘worst case’ often turns out to be benign).

On the other hand, an observer using low-gain strategies such as the ‘common-things-are-common’ heuristic more conservatively focuses on ‘common things’ and average trends in the observed information. Whereas such a control strategy is sluggish to pick up change and deviations, it is very effective at filtering noisy and misleading information. Therefore, low gain strategies such as the ‘common-things-are-common’ heuristic results, on one hand, in *few false positives* and *many correct rejections* but an *increased number of misses* on the other. Thus, the key to an ‘ideal observer’ is to set the gain in way that trades off the risks of missing a ‘worst case’ with the costs of extensive testing and preventative admissions. In other words, the competition between ‘worst case’ and ‘common-things-are-common’ heuristics reflects ED physicians’ struggle to

find a balance between safe and efficient care and a gain setting that satisfies the requirements for a stable and effectively functioning ED system.

In other words, the ‘worst case’ heuristic with its emphasis on catching the unlikely medical emergency (e.g., aortic dissection in a 21 year old patient with chest pain and mental status change) can be regarded as ED physicians’ ecologically rational, accepted method of ‘debiasing’ decision making based on ‘common-things-are-common’ rules. In turn, ‘common-things-are-common’ rules help ED physicians make efficient decisions (most of the time) without the need to admit every patient unless the physician can ‘find a reason not to admit.’ Specifically, ‘common-things-are-common’ heuristics help physicians lower the gain for those patients who seem ‘not sick’ and therefore require lesser procedures. The gain remains high, however, if ‘common things’ point to a ‘worst case.’ That is, ‘common-things-are-common’ heuristics effectively modulate the gain on care delivery procedures based on patient’s most probable state of health (‘sick’ versus ‘not sick’).

From a conceptual perspective, the ‘worst case’ and ‘common-things-are-common’ heuristics are general tools in ED physicians’ adaptive toolbox. They suggest a clear plan of action by constraining the number of symptoms to be considered for medical decision making to those clues that are most predictive of either a life-threatening or a common medical problem. In other words, both heuristics are boundedly rational because they reduce computational complexity and ignore potentially ‘noisy,’ contextual information with respect to the goal to be achieved (cf. Gigerenzer & Brighton, 2007; Gigerenzer et al., 1999). However, as general tools, these heuristics are context-independent and, if applied indiscriminately, may incur systematic decision making

biases toward safe or efficient care delivery and ultimately, suboptimal performance. That is, to exploit the benefits and avoid the pitfalls inherent in ‘worst case’ versus ‘common-things-are-common’ heuristics, ED physicians have to ascertain the patient’s potential (medical) needs (i.e., the problem space) as well as the range of potential solutions to the patient’s problems (i.e., the potential solution space). By considering ecological constraints on problem and solution spaces, ED physicians can delimit the problem(s) to be solved and identify evaluation strategies that are most appropriate to address these problem(s). As stated in the introduction, research into ecologically rational decision making has provided only scarce empirical evidence as to how people accomplish this task in complex, real-world settings (e.g., Cooper, 2000). In other words, “Exactly how people are able to determine which type of environment they are in, and then which heuristics will be appropriate to apply, remains an open question” (Todd & Gigerenzer, 2007, p. 169). Part II and III of this section will provide specific examples of ecological constraints (i.e., clue categories) the observed ED physicians considered to effectively situate their care delivery strategies in a particular (and often non-medical) environmental context.

Part II: Constraints on ED Physicians’ Problem Space

During naturalistic observations, ED physicians used their experience with characteristic constraints on emergency medical problems (i.e., the problem space) to delimit the nature, severity, and acuity of their patients’ complaints to differentiate ‘sick’ from ‘not sick’ patients and ultimately, identify the need for more or less elaborate evaluation procedures. Several different strategies can be roughly differentiated based on the kind of clues/constraints ED physicians used to categorize their patient’s complaints:

Their own clinical experience with certain types of medical problems, the patient's physical appearance, previous medical history (PMH), history of present illness (HPI), and demographics.

Categorization by subtypes of medical problems

Case 10:

A Resident suggests an evaluation and treatment plan for a 30 year old asthma patient who uses her Albuterol nebulizer³⁷ on a daily basis.

Resident: I will give her steroids.

Attending: That's the best thing you can do for her. Oral or IV doesn't matter. There is no difference in efficiency but IV may give you faster effects and if the patient gets an IV anyway.

Resident: I'll get a chest x-ray, too.

Attending: She has no fever, right? [when the nurse checked earlier, the patient was afebrile] Why do you want to get a chest x-ray? What do you expect it to show?

Resident: She may have a cold.

Attending: I don't think it will show anything. I think the patient can be treated and go home ... *Generally, I think there are 5 categories of asthma patients.* First: I ran out of meds, need new meds; Second: I have a cold, need steroids; Third: I definitely need steroids, maybe need to stay; Fourth: I probably get admitted but not intubated; and fifth: I definitely need intubated.

Case 10 provides an example of how ED physicians' experience with a certain subtypes of medical problem impacts evaluation and treatment decisions. Specifically, the example provided in Case 10 can be thought of as a more elaborate version of the 'admit or go' categorization mentioned above in Excerpt 7. Whereas the Resident suggests ordering a chest x-ray for the patient to check for a common cold, the Attending, based on his categorization of asthma patients, thinks that 'it will not show anything.' The patient described in this case clearly falls in the Attending's second category (i.e., 'I

have a cold, need steroids’) and does not require additional evaluation (i.e., the patient is ‘not sick’). Instead, ‘the patient can be treated and go home.’ The second category in the Attending’s categorization scheme suggests that no evaluation is warranted for ‘Type 2’ asthma patients and functions as a simple stopping rule. Other categories (e.g., ‘I probably get admitted but not intubated’) likely require more in-depth evaluation of a patient to decide whether or not admission is required.

Categorization by physical appearance

Case 11:

An Attending comes back after checking on a patient with shortness of breath. The Resident had ordered a CAT scan of the chest to check for pulmonary emboli (PE), standard cardiac panels, and blood cultures to test for pneumonia.

Attending: [to the Resident] Get an ABG³⁸ [arterial blood gas] *mainly because he doesn’t look good.*

Case 12:

A Resident reports to an Attending about a 4 year old patient who was brought in by his parents with a complaint of nausea and vomiting.

Resident: I can squish his belly and he keeps smiling. He is a healthy kid. He had some discharge from his ears.

Attending: Is he pulling his ears?

Resident: No. Do you want to give him Pedialyte³⁹ popsicle to see if he can keep it down? *He looks too healthy to give him anything else.*

Attending: What I usually do, I give them a script for Zofran⁴⁰ and tell them they can use it in case they need it.

Case 11 and 12 are short examples of categorization by physical appearance, which is used as a simple way to guide the further evaluation process. Whereas in Case 11 the patient’s arterial blood gas should be evaluated ‘mainly because he doesn’t look

good,’ the evaluation of the pediatric patient in Case 12 was reduced to ‘see if he can keep [a popsicle] down’ because ‘he keeps smiling [and] looks too healthy to give him anything else’ (e.g., nausea medicine).

The ecological rationality of this search rule is based on the fact that usually, healthy looking patients are healthy whereas sick looking patients are sick and only the latter category of patient requires in-depth evaluation. Thus, categorization by (visual) appearance is a simple strategy to decide whether or not a concern for (more) elaborate medical testing is warranted for a particular patient. More specifically, in the light of a particular medical problem, search rules based on (visual) appearance suggest what particular type of evaluation is most appropriate given the patient’s medical complaint (e.g., an ABG in Case 11 and a pedialyte popsicle in Case 12).

Categorization by appearance is not only limited to visual appearance. The following short examples provide evidence of more ‘invasive’ methods used to distinguish ‘sick’ from ‘not sick’ patients who presented with specific complaints.

Excerpt 9

After a Resident raised the concern that a patient with abdominal pain might have an acute appendicitis, an experienced Nurse turns to the observer.

Nurse: I went in to see her and ‘accidentally’ kicked at her bed. She is not in pain. The doctors used to do that when I was a nursing student [‘accidentally’ kicking at the patient’s bed]. If [the patients] don’t jump up in their bed, they’re not having an acute appendicitis.

Case 13

A Resident examines a 26 year old female patient with abdominal pain asking standard questions concerning the history of the present illness and the patient’s previous medical history including questions such as: How did it happen?; Did it happen before?; How does it

feel now?; Did you ever have abdominal pain before? Etc. While talking to the patient, the Resident is moving from one side of the bed to the other. On the way back to the physicians' station, the Resident tells the observer :

Resident: [to the observer] I was moving around to see if she can focus. That helps to gauge how strong her pain is. For abdominal pain we make the patient move around. That tells us a lot. This patient probably isn't that sick. I will do the typical work up for her, nothing fancy.

Categorization by previous medical history (PMH)

Case 14

A Resident goes to see a 79 year old patient who was brought in by ambulance to rule out a possible stroke or transient ischemic attack (TIA)⁴¹. The patient denies any signs of a stroke but complains of balance problems and general and left-sided weakness as well as some motor problems when trying to speak, write, or eat. The patient feels a little dizzy but her neurological exam is normal.

The patient has a history of high blood pressure, congestive heart failure (CHF), depression, type II diabetes, and a cerebral vascular accident (CVA or stroke) in 2001 impacting her right side. She states that she is 'back to normal' since then without residual weakness.

Back at the physicians' station, the Resident reports to an Attending physician.

Resident: It's not a stroke, I think. But she is uncoordinated, she has no memory loss, feels weak, denies any focal weakness ... no one can corroborate her story. EMS said she had left-sided weakness but if anything it's right sided weakness. She presented with a completely different story.

Attending: Maybe her TIA resolved?

Resident: She has neuropathy⁴² and no feeling in her [right] leg; her speech seems fine; she has family or friends here.

Attending: Work her up as a stroke. TIA has a similar workup. If she is fine with one Aspirin or Plavix⁴³, she could go home. But *if she had a TIA, she needs evaluation and be admitted*. Check with her PCP [primary care physician] if she uses [the hospitalist group], she [the PCP] used to be a Resident here with that group.

Case 15

A Resident goes to see a 72 year old male patient who was brought in by his family with a complaint of mild chest pain after light activity. The pain lasted for 2-4 minutes and improved with nitroglycerin. The first set of cardiac enzymes is negative.

The patient had chest pain on and off for the last 6 weeks in association with exertion and is scheduled for a stress test the following day. The patient had angioplasty⁴⁴ of his left descending artery in 1982 and is hypertensive. Back at the physicians' station, the Resident reports to an Attending physician.

Resident: *That's a pretty clear admission. His history alone warrants an admission. He needs a cath. [to the observer] I will get out on time.*

Attending: [to the observer] Make a note, that's a *classic angio*. [to the Resident] I need to call someone from the same [admitting] group so I can talk to them about your patient, too. I will wait for them to call. *We are not expecting aortic dissection with him so it will be a quick admit.*

Case 14 and 15 provide examples of how information about a patient's previous medical history can be used to simplify the heuristic rules used to evaluate and disposition a patient. Specifically, the patient in Case 14 did not show convincing evidence for a transient ischemic attack or TIA (e.g., the patient had a benign neurological exam and showed no residual symptoms, which would indicate a possible TIA). However, because the patient had suffered a cerebral vascular accident previously, the Attending suggested 'she needs evaluation and be admitted.' Similarly, although the patient in Case 15 presented with symptoms of only light chest pain and a negative set of first enzymes, the patient's previous 'history alone warrants an admission.' Moreover, the patient's medical history of angioplasty helped the physicians rule out alternative 'worst cases' ('We are not expecting aortic dissection with him so it will be a quick admit'). The

next Case is taken from the same set of observations as Case 15 – that is, the Resident and Attending physicians are identical – to provide an example of a patient with chest pain who had *no* prior history of heart disease.

Case 16

A Resident goes to see an 82 year old patient who was sent in from an urgent care center due to a complaint of intermittent chest pain and slight dizziness. The patient had 2 episodes of chest pain over the last 3 days. The pain ‘comes at once and it goes away just as fast’ and occurs when the patient is resting. Each episode lasts for about 10-20 minutes. The pain does not radiate and cannot be replicated with palpation. This is the *first time* the patient experienced chest pain. The patient has no other medical problems and the only medication he uses is one Aspirin per day and ‘something for my memory.’ The patient has *no family history of coronary artery disease*.

The patient does not want to stay in the hospital for observations: ‘I keep away from doctors and don’t let them give me lots of meds.’ The patient’s EKG shows no ST elevation but a right bundle block. No old EKGs are available for comparison. The physical exam and a first set of enzymes are negative. Back at the physicians’ station, the Resident reports to an Attending physician.

Resident: He is sharp and pretty with it. He had 2 episodes, each 2-3 minutes; no diaphoresis, no nausea or vomiting; he felt a little dizzy. He has no prior history of heart disease; he had only hemorrhoid surgery. His first set of enzymes is negative and his x-ray looks good.

Attending: *Sounds like you do a rule out and send him home ...* and talk to his cardiologist or his PCP who he wants to refer to.

Case 16 provides an example of how the lack of a previous history with a medical complaint can be used to simplify the evaluation and admission decision. Specifically, the patient in Case 16 presented with a complaint of intermittent chest pain over the previous three days. However, the patient had a normal physical exam, chest x-ray, EKG, first set of cardiac enzymes, and no ‘prior history of heart disease.’ Thus, the Attending suggested

that, if the obligatory medical tests for chest pain are negative, the patient can be discharged home to follow up with a cardiologist ('Sounds like you do a rule out and send him home').

In sum, the ecological rationality of categorization by previous medical history is based on the fact that in patients with a previous history of an acute medical problem, the presentation of typical symptoms of this problem is associated with a high likelihood that the patient is again having this problem. Consequently, these patients warrant a more thorough work-up and/or admission to the hospital (see Case 14 and 15). On the other hand, for patients without a previous history of an acute medical complaint, it is less likely that generic symptoms such as chest pain point to a 'sick' patient with a medical emergency (see Case 16). Instead, standard laboratory tests and adequate follow-up should suffice to rule out an unlikely 'worst case.' Thus, categorization by previous medical history is a simple strategy to decide whether or not a concern for (more) elaborate medical testing and/or admission is warranted for patients who present with symptoms that may point to both benign and potentially life-threatening medical problems⁴⁵.

Categorization by history of present illness (HPI)

In the interest of keeping the length of the present discussion in an acceptable range, a previously mentioned case will be used to illustrate the effect of HPI on ED physicians' reasoning. Specifically, Case 9 described the case of a patient who presented with 'two to three days of acute sinus symptoms' and 'one episode of coughing with consecutive chest pain.' Based on this information, the attending physician suggested that 'it's not the heart.' Instead, it was more likely that the patient was suffering from a benign

problem such as pneumonia. Therefore, the attending physician reduced the evaluation of the patient to ‘a mini work up’ that would rule out cardiac problems with a single test (one set of cardiac enzymes, which shows cardiac exertion) and try to find evidence for an alternative, more likely explanation (e.g., pneumonia). Another example in this category can be found in Case 3, which describes a patient with a syncope episode who had a heart catheterization the previous day. Given this coincidence, the attending physician considered the heart catheterization as part of the patient’s HPI. This conjecture led the physician to think that the catheterization procedure might have caused ‘a little dissection’ in one of the blood vessels surrounding the patient’s heart. An ultrasound, ordered to rule out a possible dissection, eventually identified the life-threatening condition of a deep vein thrombosis (DVT). In sum, Case 9 and 3 are representative examples of how the observed ED physicians used their patients’ HPI to constrain likely medical problems and chose appropriate evaluation strategies.

Categorization by demographic variables

Also to illustrate the use of demographic clues, a previously stated example can be used. Case 4 described the case of a 47 year old, female patient with multiple complaints such as headache, bloody cough, chills and sweats, diarrhea and chest pain, which she had experienced three days earlier. Also, the patient was tachycardic with a heart rate of 117 beats per minute. Although the patient had no previous history of cardiac problems such as myocardial infarction (MI), the attending physician’s main concern was related to the epidemiological implications of the patient’s demographics for a potential heart condition. That is, the patient was evaluated for potential cardiac problems (i.e., ‘worst cases’) because ‘she [was] 47 years old, she [was] a women⁴⁶, not

hypertensive but tachy[cardic].' Apart from demographic information, epidemiological trends and relationships in general have hitherto been associated with fast and frugal heuristics in medicine (cf. Gigerenzer & Kurzenhäuser, 2005; Green & Mehr, 1997; Wegwarth et al., 2009).

Categorization by multiple constraints

Case 17:

A Resident to the observer about a 38 year old female patient with a complaint of pain and swelling in both her back and abdomen.

Resident: The patient had a brain mass [it was recently surgically removed]. She also has a history of OD [drug overdose]. She may have metastasis somewhere, so I will be more suspicious but careful with giving narcotics. Also, all females with pain between the knees and the head are pregnant. I also check how many scans she got to prevent too much radiation.

So far examples have focused exclusively on particular clue categories. Case 17 provides a short but telling example of how the observed ED physicians took advantage of multiple constraints to delimit the medical problem at hand and select appropriate decision strategies. In Case 17, a Resident describes how to best evaluate a patient complaining of back and abdominal pain, which was complicated by several factors. Specifically, the patient had a brain tumor making the Resident suspicious that 'she may have metastasis somewhere,' which could cause her pain. Search for potential metastasis would require extensive screening (e.g., a CAT scan). However, given that the patient had a history of brain cancer it was important to 'check how many scans she got to prevent too much radiation.' With respect to pain management, the patient's history of drug overdoses suggested to the Resident that it was important to be 'careful with giving narcotics' when relieving the patient's pain. Moreover, given that the patient was female

the administration of narcotics required a pregnancy test to check if the pain was due to an undetected pregnancy ('All females with pain between the knees and the head are pregnant'). In the case of a pregnancy, the patient would not have been eligible to receive standard pain management to avoid harm to the unborn. In sum, Case 17 provides a non-exhaustive list of the kinds of constraints and their combinations ED physicians used to delimit the problem at hand. However, this example illustrates that ED physicians (most) often considered multiple constraints to delimit the range of possible medical problems and identify adequate evaluation strategies.

Conceptually, the above example cases showed that ED physicians can effectively ground the use of the general 'worst case' and 'common-things-are-common' heuristics in a particular situation by taking advantage of the integral web of constraints that help delimit the range of a patient's medical problems to be considered in the ED. By using one or integrating over a combination of constraints, ED physicians described in the above example cases were able to provide structure to the evaluation process (reduce ambiguity about what to do) and ultimately, find a situationally grounded rationale to decide the tradeoff between medical safety and efficiency. However, the ecological rationality of ED physicians' care delivery strategies are not only bound by constraints on medical problems (e.g., those described above) and/or results of medical tests/studies. The last two examples in Part II will be used to illustrate that care delivery in the ED is not merely problem-driven but equally bound by ED physicians' goals to disposition patients based on the nature, severity, and acuity of their medical problems and, more generally, the options available for action (i.e., the solution space).

Case 18

After two hours of evaluation, an Attending goes to speak with the family of an ALS [Amyotrophic Lateral Sclerosis⁴⁷] patient who was brought in by ambulance with a complaint of vomiting and increased confusion. The Attending reports back to family concerning test results and further steps.

Attending: [] We have *more questions than answers*. I will call [the admitting physician] with all his vomiting and confusion. We will admit him and look into things further.

Case 19

An Attending talks to the observer about a patient who came in with a combination of vaginal bleeding, abdominal, and chest pain. The physician worked the patient up for cardiac and abdominal issues. All tests came back normal except one of the cardiac enzymes (Troponin) is elevated.

Attending: Her labs are not normal. She is bleeding vaginally. *Very confusing... she'll probably stay*. I'm behind on her because I was ignoring her ... sometimes that happens because she is a difficult case ... doesn't fit anywhere.

The patient tells the nurse that she would like to go home.

Attending: The only thing I found is a blood test for heart disease. It's not bad but suspicious. But you may simply have menstrual cramps. [] I know, we don't know what's going on ... do you really want to go home?

Patient: Ok then, I stay. Can I eat now?

Attending: Not as long as you have belly pain. We need to figure out what's going on.

Case 18 and 19 are two short examples demonstrating how the level of ambiguity inherent in two medical cases could not be reduced because the patients did not 'fit anywhere.' Even after evaluating the patient in the ED, the patients' state of health was 'very confusing' confronting the physicians with 'more questions than answers.' Instead of pursuing evaluation further in the ED (which is bound by resource limitations and time pressure), the physicians identified their patients as 'sick' enough to warrant further

evaluation in the hospital. By taking advantage of the fact that ED physicians' central task is not to diagnose but to identify patients who need to stay in the hospital (or can receive follow up care as an outpatient), these physicians were able to use a constraint on possible solutions to their patients' problems (i.e., admission for further testing) to terminate evaluation in the ED. These two extreme examples suggest that the selection of an appropriate evaluation strategy cannot be completely understood without considering the range of possible solutions to a patient's problems. Part III of this section will describe how the observed ED physicians actively used the structure and bounds on the solution space to delimit care delivery strategies in the ED.

Part III: Constraints on ED Physicians' Solution Space

The class of ecological constraints discussed in this section is, just like the one elaborated above, based on the fact that ED physicians' central task is *not* to diagnose but to identify patients who are 'sick' versus 'not sick' and warrant admission to the hospital versus discharge with outpatient follow up. Given steadily increasing patient volumes in U.S. Eds (NCHS, 2007)⁴⁸, ED physicians have to effectively allocate medical resources. Moreover, given a patient population with increasingly diverse and specialized needs (IOM, 2006)⁴⁹ ED physicians have to act as gate keepers who effectively refer patients to those care providers in the health care system who can best address a patient's medical needs. Examples in this third Part will show that constraints on potential solutions to a patient's problems (i.e., disposition decisions) are grounded in the U.S. health care and ED/hospital systems as well as characteristics of the patient and the physician. It will be shown that by impacting the range of potential solutions to a patient's problem, these

constraints modify the problem to be solved in the ED, which allows and at the same time necessitates ED physicians to adjust their evaluation strategies.

The main difference between the class of constraints described in this section and the one described above is that these constraints are not used to directly identify whether a patient is likely ‘sick’ or ‘not sick’ (i.e., they do not operate on the problem space). Instead, ED physicians used these constraints to *situate care delivery* in a particular context by taking advantage of the constraints on what can be done for a particular ED patient (i.e., the options and implications of a possible disposition). Specifically, ED physicians used these constraints to delimit problems and identify solution strategies that must, should, or may be effectively implemented given the contextual constraints on action such as the availability of resources, organizational regulations as well as sociocultural values. The following examples will describe strategies the observed ED physicians used to work effectively with and around environmental constraints on the solution space and, ultimately, determine whether or not a certain action must, should, or may be taken to evaluate and/or disposition a patient.

As for the constraints on the problem space identified in Part II, the description of constraints on the solution space can be roughly differentiated with respect to the types of constraints ED physicians used to situate their evaluation strategies in a particular care delivery context: Constraints on action pertaining to the health care and the ED/hospital’s organizational system, those constraints introduced by specific classes of patient characteristics, and those introduced by physicians’ previous experience.

Constraints pertaining to the health care system

Case 20

A Resident reports to an Attending about a 48 year old female patient who has something that looks like reddish insect bites on her chest, arm, back, and waist.

Resident: The patient is not presenting as typical scabies. She has erythema⁵⁰ around her hair follicles. Nothing concerning.

Attending: Is she itching?

Resident: Yes. She strikes me as someone who took drugs in the past. She denies drug use at the moment but she is not the brightest person in the head.

Attending: *Ok, go to the derm clinic. Everybody with some skin thing goes to the derm clinic, that's our service for skin patients.* [] Let's send her for follow up to the derm clinic at []. It's a resident-run derm clinic that takes uninsured⁵¹. That's good for our population. Not like the dermatologist who says: give me your \$200 before I see you. I will go with you to look at the patient [] what it could be is mites... but that's not likely it... give her some topical stuff.

After having seen the patient.

Attending: [to the Resident] Give her Atarax⁵². That's best for itching and it's cheap, also.

Case 20 is an example of an ED physician taking advantage of how expertise is distributed in the U.S. health care system (cf. Shi & Singh, 2008). Although ED physicians may consider themselves as generalists who are 'second best at everything' (Brown, personal communication, September 12, 2008), certain medical problems may require skill sets that can be better satisfied by a different specialty ('Everybody with some skin thing goes to the derm clinic, that's our service for skin patients'). In Case 20 the patient had 'nothing serious' (i.e., was not 'sick' and could be discharged with follow up), which, in combination with a skin problem, reduced the ED physicians' work-up to 'look[ing] at the patient' and providing 'some topical stuff' and an antihistamine (i.e., Atarax) before referring the patient to a dermatology clinic. Thus, example Case 20

showed that ED physicians can use the distribution of expertise in the health care system to simplify the selection of adequate stopping rules. Similar evidence could be identified with respect to the distribution of responsibilities for particular medical problems across health care providers. See Case 21 for a short example.

Case 21

A Resident checks test results for an 89 year old female patient who came in with back and shoulder pain.

Resident: Her creatinine⁵³ is low.

Attending: [after looking at the patient's previous creatinine values in the computer system] Looks like *the value is within her range, she is always kind of low*, how is she doing?

Resident: She looks comfortable.

Attending: *I don't do anything with that. You're not gonna fix that. She is in for her back pain. I let somebody follow up. Just make sure somebody knows about it.*

Case 21 provides an example of how ED physicians may exploit the constraints underlying the distribution of problem ownership across the health care system.

Specifically, during the evaluation of the patient, the Resident identified an out-of-the-norm value ('Her creatinine is low'). The Attending stated that the patient was 'in for her back pain' and identified – based on a categorization by previous medical history – that the value was chronically low and therefore did not require intervention ('I don't do anything with that') because in the ED 'you're not gonna fix that.' Instead of initiating evaluation and treatment of the patient's abnormal value, it is sufficient to 'let somebody follow up' by making 'sure somebody knows about it.' Thus, ED physicians can exploit the constraints of a health care system marked by the distribution of expertise and responsibilities (cf. Shi & Singh, 2008) by referring chronic problems and problems

without immediate concern for a ‘worst case’ (i.e., patients who are ‘not acutely sick’ with respect to a particular medical problem) to the appropriate care provider.

The examples have shown that the constraints afforded by a health care system that is marked by the physical and organizational distribution of expertise and responsibilities provides ED physicians with a simple and ecologically rational way to delimit the problems being addressed in the ED, which ultimately, may help maintain ED functioning under high workload. However, there is also a downside to this strategy. The following example will describe the consequences associated with a similar strategy as it is used by other care providers in the U.S. health care system.

Case 22

An Attending physician tells the observer about a patient with a ‘Do-Not-Resuscitate: Comfort Care’ (DNR-CC) order who was brought in from a nursing home.

Attending: The patient has chronic leg pain. She got Darvocet⁵⁴ four hours ago, so she cannot get it for 2 hours. And they [the nursing home staff] sent her here. They could have given her Vicodin or Morphine. I know they have it there. Now, the tax payer pays \$400 for the ride, \$400 to me to go into the room and say it’s chronic DNR-CC, give her meds and send her home plus another ride for \$400.

Case 22 provides a short example of a patient with chronic leg pain who was brought to the ED by ambulance for further evaluation of her problems. However, the ED physicians, specialized to provide care to acutely ‘sick’ patients, were not able to supplement the patient’s care in a significant way because the patient was ‘not sick’ from the ED physicians’ perspective (‘it’s chronic DNR-CC, [the physician will] give her meds and send her home’). In the physician’s mind, sending this patient from the nursing home to the ED and back resulted in wasted resources. This example suggests that there is a *macro tradeoff* (between local and systems functioning) underlying the effectiveness

of care strategies based on patient referral. That is, these strategies may reduce cognitive and physical work for the referring party (i.e., at the *local level*) but incur costs, financially and in terms of additional medical work-ups that need to be performed elsewhere in the health care system⁵⁵ (i.e., at the *systems level*). The macro tradeoff between local workload (in the nursing home) and the availability of more distal resources (in the ED) may not be immediately obvious to a care provider. This indicates that the ‘macro’ effectiveness of heuristic responses to constraints of a distributed health care system depends on the care providers’ awareness of this tradeoff and more specifically the types of organizational/systemic resources tapped by their decision.

Constraints pertaining to the ED/hospital’s organizational system

Case 23

A Resident reports to an Attending physician about a patient with blood in the urine (hematuria).

Resident: He has hematuria⁵⁶ and left sided back pain. I will get a UA [urinalysis], don’t know what else.

Attending: CBC [Complete Blood Count], BMP [Basic Metabolic Panel] and call urology.

Resident: He may have kidney stones.

Attending: *He has no pain though. We hold off ... he has no history of stones, right?*

Resident: No.

Attending: *We can always scan him later.*

Case 23 is an example of how ED physicians’ may take advantage of the constraints inherent in the ED workflow. Particularly, for the patient in Case 23, the Attending did not consider it relevant to check for kidney stones during an initial workup. Instead, the physician used a ‘hold-off’ rule, which could be observed repeatedly in attending physicians’ interactions with Residents. This ‘common-things-are-common’ strategy was used if there was no evidence to suggest that a particular screening test was

warranted at a certain point in time (e.g., ‘He has no pain though [and] he has no history of stones, right?’). In these cases, the need for certain medical tests (e.g., an expensive CAT scan) may be ruled out by simply waiting for basic laboratory tests such as a Basic Metabolic Panel (BMP) or Complete Blood Count (CBC) and/or input from consultant specialists (e.g., an urologist) who might request the test to be done at a later time. In other words, if information is incomplete and the patient probably does not warrant immediate intervention (i.e., the patient is likely ‘not sick’ with respect to a particular disease) ED physicians may delay the order of tentative medical tests until the situation (e.g., laboratory results or a consultant) provides the physician with *feedback* that suggests ordering the test.

Although this strategy may provide physicians with a simple strategy to prevent inefficiencies during the evaluation process, if the test becomes necessary at a later time, this rule incurs costs for the patient (e.g., a treatment delay, longer stay in the ED) and the ED as a whole (e.g., the patient’s bed remains occupied reducing the ED’s bed capacity). The following Case 24 is another example where the constraints inherent in the ED workflow are exploited by an ED physician’s evaluation strategy. However, the effectiveness of the described decision strategy is based on the exploitation of the *feed-forward* instead of feedback dynamics inherent in the ED workflow.

Case 24

An Attending and Resident talk about further orders for a patient they would like to admit based on evidence for multiple disease processes.

Attending: This patient’s troponin is up. *Will you order a drug screen on this patient?*

Resident: Why? [in a joking way] You’re spending tax payers’ money? *What is it gonna do?*

Attending: So medicine⁵⁷ is not going na na nana na...

Resident: *We can give medicine seven reasons to admit him.* We can sell him as: 1. Chest pain – cocaine induced; 2. Hypertensive urgency; 3. Cellulitis; 4. Renal failure, 5. Elevated troponin; 6. Hyperkalemia; Did I mention his blood pressure is 205 over 90 and his glucose is 242.

Attending: *And medicine is giving you seven reasons not to admit him...* his potassium was up before... but, but, but ...

Resident: [to the observer] We teach our med students about ‘admit or go.’ If a patient gets admitted, *we order more tests because medicine wants it.*

Case 24 describes a situation where a ‘sick’ patient has been diagnosed with multiple medical problems providing the Resident with several reasons he ‘can give medicine ... to admit him.’ Thus, the Resident thinks that additional testing is unnecessary (‘What is it gonna do?’). However, to provide a sound rationale to admit the patient and circumvent potential hold-ups in the admission process (‘medicine is giving you seven reasons not to admit him’), the Attending physician suggests ordering an additional test (‘Will you order a drug screen on this patient?’). Thus, the simple strategy of ordering ‘more tests because medicine wants it’ may increase the chances that a patient gets admitted without having to engage in lengthy arguments with an admitting physician (‘but, but, but’). On the other hand, the strategy of ordering tests preventatively may, if the admitting physician does not require the ordered test, trade off efficient admission procedures with additional costs and decreased ED laboratory resources.

Constraints introduced by the physician's experience

Excerpt 10

A Resident and an Attending discuss the case of an 89 year old female patient who came in with a complaint of back and shoulder pain. The pain had started the night before and was radiating to the front when the patient woke up.

Attending: Maybe it's shingles

Resident: That's my suspicion. She had it before on her leg. It may well be that shingles become visible in 24 hours.

Attending: If she has shingles already somewhere and they show up somewhere else it would be an admit for disseminated zoster. *I made that mistake before and sent her for follow up with the clinic; they sent her right back during the same shift. So that's something to consider.* []

Excerpt 11

An Attending and a Physician Assistant (PA) discuss the CAT scan results of a 49 year old male patient who came in with a complaint back and neck pain.

Attending: He has bulging discs: C4, C5, that's acute ... *pretty concerning. I got sued for one of those.* Call the neurosurgeon if he will see him. *Glad I ordered that useless CAT scan.*

Excerpts 10 and 11 provide two short examples of how ED physician use their prior experience with the outcome of certain care delivery situations to adjust the evaluation process. Specifically, in Excerpt 10 the physician had prior experience with a patient who presented with similar symptoms (i.e., back and shoulder pain). The attending physician had 'sent [the patient] for follow up with the clinic.' However, the patient ended up having an episode of disseminated zoster, which warranted admission ('they sent her right back during the same shift'). So to avoid making this same mistake again, shingles was 'something to consider' during the workup of this patient who

presented with similar symptoms. Similarly, in Excerpt 11 the physician had been sued for missing to identify a bulging disc in a patient. Thus, the physician was careful and ‘ordered that useless CAT scan’ for a patient with symptoms (i.e., back and neck pain) that were potentially associated with a bulging disc. In Excerpt 11, the physician used the salience of a previous similar event effectively to identify a bulging disc. This finding relates to research investigating dermatologists’ diagnostic skills where previous exposure to certain symptom combinations improved diagnostic accuracy on similar cases, even after a 2 week interval between the presentation of training and test cases (e.g., Brooks, Norman, & Allen, 1991; Norman, Rosenthal, Brooks, Allen, & Muzzin, 1989).

Constraints introduced by the patient

Case 25

An Attending goes to see a 72 year old male patient with abdominal pain.

Attending: Good morning, what brought you in today? I have seen on your chart that you came all the way from W.?

Patient: Yeah, that was quite a trip! My belly hurts... it feels like I need to have a bowel movement or like I’m hungry.

Attending: Have you seen your family doc?

Wife: They evaluated him for a rupture... and diverticulitis... he is scheduled for a CAT scan next week.

Attending: [to the patient] So you will get the scan here today. [starting with the physical exam]

Attending: Did you have something like this before?

Patient: I had diarrhea a month ago... that was painful.

Patient: Yes.

Attending: Did you get antibiotics for that? Did that make it better?

Attending: Did they check you for a kidney infection or kidney stones?

Patient: No.

Attending: Did somebody tell you about something called an aneurism?

Patient: What's that?

Attending: So they didn't, you would remember ... do you still have your appendix and gallbladder?

Patient: Yes. []

Attending: Ok. We will get a cat scan, check your blood to see if your white count is up ... that's usually the sign for an infection. And if you can pee for us we can also make sure you're not havening a urinary tract infection ... your tenderness seems more colon than bladder related to me... you have more pain on the right, that's where your appendix is... it could be a bladder or kidney stone... or an aneurism so we'll check for that, too. [jokingly] You're not pregnant, are you?

Attending: Do you need any pain meds or something for nausea?

Patient: That would be good!

Attending: [while leaving to the observer] He has already been worked up for pancreatitis but with his right-sided pain, I'm more concerned about appendicitis ... it really makes no difference to me, it's the same treatment: pain and nausea meds, antibiotics and he cannot eat anything because he might need surgery... but he is from W. that is 2.5 hours from here. I don't want him to come back in tomorrow so *I will make sure he is fine if he is going home.*

Case 25 provides an example of how an ED physician used the patient's personal circumstances to situationally adjust the categorization of the patient as 'sick' versus 'not sick.' Specifically, from a 'worst case' perspective, the physician was concerned about an acute appendicitis or an abdominal aortic aneurism (AAA). Although the identification of the patient's particular problem did not matter to the ED physician (i.e., the task is not to diagnose), it was important in this particular situation to 'make sure he is fine if he is

going home' and detect any signs of early appendicitis or pancreatitis. That is, because the patient lived 2.5 hours away from the ED, it was clear to the physician that this patient would not have been able to come right back in case of a worsening condition. Thus, the physician lowered the threshold of the admission criterion. Or, in other words, the physician increased the gain of the evaluation process to identify early signs of any potential 'worst case.'

Conceptually, by lowering the admission threshold the physician was able to narrow down 'medically' open constraints and adapt the disposition decision to the particular situation of the patient. By doing so, the physician traded off a more thorough evaluation with saving the patient precious time, unnecessary pain, and potential danger in case of a later worsening (although not yet detectable) 'worst case.' From a systemic perspective, admitting this patient for observations may trade off hospital resources with the costs of another comprehensive work up in the ED if the patient had been sent home but needed to come back in at a later time.

The next Cases will provide examples of how a patient's actual needs and concerns may not be immediately obvious but have to be 'discovered' by *listening to the patient*. The example shows how awareness of these '*hidden*' needs may lead physicians to *reframe* care delivery strategies.

Case 26

An Attending goes to see a 71 year old female patient who was brought in by ambulance with a main complaint of nausea.

Attending: What's going on for you?

Patient: I have chronic gastritis for years, it was better for a while but it started again end of July. My doc scheduled an endoscopy for next week, he checked my pancreas, they did a cat scan of the gallbladder here at the hospital... they also did a colonoscopy and removed a couple of polyps. I'm scheduled for a second endoscopy next week.

Attending: Did you change anything recently... your eating habits?

Patient: No, I eat a pretty restricted diet, lots of fruits and vegetables... but I'm always nauseous. I take Phenergan for it...

Attending: Is it better at night?

Patient: No, I'm just sick. [the patient starts crying and tells the doctor what treatments and methods she has tried already. The Attending listens, then continues interviewing]

Attending: Do you throw up?

Patient: No, but I'm always nauseous, I have no appetite.

Attending: Is there anything that worked for you to make it better, maybe IV fluids, most people get better with some fluids...

Patient: I don't know. I used 2 doses of Prilosec last night and Peptobismo... that helped but only for a little while. []

Attending: Is there anybody sick at home ... or are you living by yourself?

Patient: I live by myself.

Attending: I saw on your chart you have two doctors, who is most in charge?

Patient: The gastroenterologist ran all my tests...

Attending: So you are throwing up or just nauseous?

Patient: I'm nauseous; it feels like I'm hungry. []

Attending: Are you anemic?

Patient: I was last year but I don't know now...

Attending: They should have told you if you were anemic...

Physical exam

Attending: Did you try any other nausea meds? I know Phenergan can make you all dopey...

Patient: No.

Attending: [] You still have your gallbladder and appendix?

Patient: Yes, I think it is my gallbladder, I don't know what else it could be...

Attending: Ok, I'll figure out a plan for you and will be back to let you know...

While leaving the room, the attending tells the observer:

I think she is basically depressed and needs somebody to talk to... the first thing I check is: is there anything that is easily fixable? Then I ask myself if the patient needs admission or not. She probably doesn't... she wants to, otherwise she wouldn't have come in with her chronic issues... there are 7 nausea meds out there... if she has only tried one, it makes me think her PCP [primary care provider] doesn't really know how she is doing... she may tell him that she is getting along with Phenergan and he may not see her exacerbations because she comes to the ER with it ... or she may not tell him... I will call him to see... [It turned out the patient's PCP was out of town so the patient came in to get help in the ED]

*So my work-up is going to focus on finding a reason to admit her... but starting Friday no doc wants to admit anyone because they don't want to be here over the holidays⁵⁸ ... [it's two days before Christmas]. I will order the usual screening labs [CBC, BMP, cat scan of the abdomen], give her some Zofran for nausea and Ativan: *That's what she really needs; it calms her down* and has some anti-nausea effect as well. I'll see what I can do for her... *normally I ask a social worker to talk to patients like her... but not for her*; she is older and older patients think we think they are crazy when we do that... The Attending eventually discharges the patient (because all test results came back normal) with advice about possible next steps and follow up examinations.*

Case 26 provides an example of how an ED physician was able to structure and constrain the care delivery process based on an understanding of a patient's emotional needs and personal history with her complaint. Specifically, by listening to the patient's 'story,' the Attending was able to realize that medical care would not have been a

sufficient solution for this patient. Instead, the Attending recognized that the patient ‘is basically depressed and needs somebody to talk to’ and *wants* to be admitted because ‘otherwise she wouldn’t have come in with her chronic issues.’ Based on this understanding of the problem, the physician redefined the goal of the workup from primarily identifying ‘sick’ versus ‘not sick’ patients to ‘finding a reason to admit her.’ To do so, the Attending could fall back on standard clinical protocols: ‘I will order the usual screening labs’ for abdominal complaints and ‘give her some Zofran for nausea.’ Moreover, to address the patient’s psychological needs, the physician was able to identify the appropriate constraint on the problem space. That is, based on an awareness of the specific implications of the patient’s emotional agitation and demographics, the physician ruled out the ‘normal’ solution for such patients, which is to ‘ask a social worker to talk to patients like her.’ Instead, because ‘she is older and older patients think we think they are crazy when we do that,’ the Attending adjusted the care delivery strategy (‘I’ll see what *I* can do for her’) and gave the patient ‘what she really needs,’ Ativan to calm her down.

From an emergency medical perspective, the main problem in Case 26 was to rule out ‘worst cases’ with respect to a complaint of nausea in a 71 year old female with a history of gastritis. However, the Attending physician suspected that, from an emergency medical perspective, the patient ‘probably doesn’t’ need admission. Instead, based on an understanding of the patient’s situation, the physician identified a different problem, the emotional needs underlying the patient’s complaint. These additional constraints on successful care delivery were not immediately obvious but required psychological skill relating to the patient and her problem. However, the constraints introduced by the

patient's *actual*, emotional needs were vital in selecting targeted strategies to effectively address the patient's 'complaint' with the medical resources available. Thus, Case 26 seems to suggest ED physicians have to cope with a problem space where "To envisage, to put the right problem, is often a far more important achievement than to solve a set task" (Wertheimer, 1959, p. 243). The final example of constraints pertaining to the patient will describe a problem similar to the one presented in Case 26 but very different with respect to the outcome.

Case 27

11:38 pm

An Attending goes to see a 41 year old male patient complaining of chest, abdominal pain, and kidney problems. The patient's pain started about 4 weeks ago after a gallbladder surgery. The patient is dissatisfied because he has sought help in a different ED previously but without lasting pain relief or information about potential underlying causes. The patient is on Coumadin⁵⁹ (due to a valve replacement 2 years ago). The patient states that he has no insurance and his Medicaid is pending but he hoped that he would be seen ('I thought I'm coming in because you will perhaps see me like last time').

The Attending decided to give the patient pain medication and run repeat tests (i.e., a CAT scan of the pelvis and abdomen; a chest x-ray; Complete Blood Count (CBC); Basic metabolic Panel (BMP); Urinalysis; EKG; and normal saline).

The Attending also reviews the patients previous medical history (PMH)

Attending: Very interesting. He has a history of afib⁶⁰, AP [abdominal pain], and chest pain. He does this quite a bit [comes in with the same complaint over and over again]. The problem is now and then even the crazy people get sick. He gave the same story at [the other hospital]. He is 41 years old. God! He had a [cardiac] cath in April, several echos⁶¹, a stress test on 11/12. He takes Lanoxin⁶² and they question his compliance. [in an ironic tone] Really do you think?!

1:28 am

The test results are back and the Attending informs the patient about the findings.

Attending: Good news first?

Patient: Yes.

Attending: You have no abscess or blood clots; no pancreatitis; your heart is ok; your Coumadin is a little high but not bad; you have nothing dangerous.

Patient: What about my kidneys?

Attending: They checked fine. The bad news: We cannot figure out what's wrong with you ... and *admission is not a good idea with your history and records* [the patient came in with the same problem before]

Patient: But I cannot continue like that, I don't feel well and I want to know what's wrong with me.

Attending: I agree, treating the symptoms is not a solution. *But we are here to find and take care of the bad things. We can't figure out what is wrong with you tonight.*

Patient: I want to feel comfortable for one night at least. If I can stay here ... or in the waiting room if you don't mind. I live 26 miles away; I cannot take a cab.

Attending: Our ED policy does not allow you to stay here or the waiting room, I'm sorry. I will get your discharge papers ready.

Case 27 depicts essentially the same situation as described in the previous example Case 26. The patient is desperate ('I cannot continue like that'), presents with a chronic complaint, which probably does not warrant admission ('He has a history of chronic afib⁶³, AP, and chest pain'), and wants to stay in the hospital ('I want to feel comfortable for one night at least'). However, unlike in Case 26 the Attending in Case 27 does not intend to find a reason to admit the patient but provides the patient with a rationale for why 'admission is not a good idea.' Specifically, the Attending's rationale for *not* admitting the patient is based on the patient's 'history and records,' which suggest that the patient has been admitted numerous times, obtained elaborate medical evaluations, and is apparently non-compliant with the prescribed treatment regimes ('they

question his compliance’)⁶⁴. Thus, without convincing medical evidence (e.g., a ‘worst case’), it is unlikely that the patient can be admitted again this time. Therefore, to avoid investing more time and resources in an unlikely outcome, the Attending decided to terminate care delivery against the patient’s requests.

Summary of Part II and III: Constraints on problem and solution spaces

The examples presented in Part II and III of this section have shown that the observed ED physicians took advantage of constraints on problem and solution spaces to situate the selection and implementation of care delivery strategies with respect to the patient’s (medical) needs and potential disposition. In other words, by exploiting constraints on medical problems and constraints on action, ED physicians were able to delimit the problem to be solved and identify the degree to which an appropriate evaluation strategy had to rely on a safe but (sometimes) inefficient ‘worst case’ strategy or could take advantage of an efficient but (more) risky ‘common-things-are-common’ strategy.

The above evidence suggests that ED physicians’ use of constraints on problems and actions is associated with two tightly interconnected safety-efficiency tradeoffs, one at the individual (local) level and one at the systemic level. Both tradeoffs can be illustrated with respect to the decision ED physicians have to make about whether to ‘hold off’ or ‘go ahead’ with ordering additional but tentative tests for their patients. On one hand, a physician may ‘hold off’ to prevent ordering unnecessary studies. If testing becomes necessary at a later stage, the use of an efficient strategy at the individual (e.g., the ED physician’s) level may be traded off with individual- level costs related to the risk of treatment delay and longer ED stays for the patient (see Case 23) but also systemic

costs such as a decreased bed capacity in the ED (see Case 23) and/or the unnecessary use of laboratory resources (see Case 24). On the other hand, if a physician ‘goes ahead’ and orders tests to ‘be on the safe side’ but these tests were ordered unnecessarily, safety at the individual (e.g., the patient’s) level is traded off with inefficient use of systemic resources. Although conceptually interesting and important, the tradeoff at the systemic level is often outside the awareness of individual actors (see Case 22) and it is beyond the scope of the present research to trace the repercussions of the systemic tradeoff.

However, the findings of this research provide evidence that ED physicians were able to satisfice with respect to the safety-efficiency tradeoff at the individual (local) level.

Based on the evidence, ED physicians resolved safety-efficiency tradeoffs at the individual level, on one hand, by exploiting constraints on the range of potential (medical) problems such as their previous experience with certain medical problems, patients’ physical appearance, PMH, HPI, or demographic/epidemiological information. On the other hand, ED physicians complemented this problem-driven strategy by grounding evaluation strategies in the constraints on action associated with the U.S. health care system, their ED/hospital organizational system, and with respect to the characteristics of patients and their own experiences. Once ED physicians *framed the problem to be solved* around these constraints, the range of possible solutions/decisions was reduced to a few workable ones so that it was rather easy to decide (and sometimes self-evident) when it was a good (i.e., safe and efficient) decision to refer patients to a specialist, when to (not) order additional medical tests, or when to address or reject patients’ needs. Thus, experience with the categorization of patients into ‘sick’ (to be admitted) versus ‘not sick’ (to be discharged) patients on one hand (i.e., (re)structuring

the problem space) and awareness of constraints on action and resource constraints on the other (i.e., (re)structuring the solution space), provide ED physicians with a good guess about which care delivery strategy will most likely improve care delivery safety and effectiveness for their patients and the ED.

In summary, the above evidence suggests that emergency medical care is not provided in a vacuum but in a rich environmental context, which influences how ED physicians make their decisions (cf. Geertz, 1986; Lave, 1987). The main finding of this section is that constraints on (medical) problems and possible actions provide ED physicians with a simple way to transform complex into more manageable problems and select workable, situationally adequate solution strategies. In other words, ED physicians exploit these constraints to perform what Duncker (1945) had labeled *problem restructuring* in that “knowledge which is no longer sufficiently definite [i.e., ill-structured] is ‘bent into suitable [well-structured] form’ for a solution” (p. 39). This finding provides a first explanation of how ecologically rational ED physicians ascertain (or better *negotiate*) what kind of task environment they are in and, consequently, which decision strategies to select from their adaptive toolbox. Conceptually, the observed strategies are based on a process of ‘satisficing under constraints,’ which results in the selection of (at least) *locally efficient*⁶⁵ and *safe* care delivery strategies. This contention will be elaborated from a conceptual perspective in the following paragraphs.

Satisficing under constraints. Traditionally, physicians’ problem space has been defined around their patients’ complaints (i.e., physical findings and symptoms). The above findings suggest that the health care system, the ED organization, the patients’ as well as the physicians’ concerns and preferences provide contextual constraints or

‘backgrounds’ against which patients’ complaints and potential solutions are identified and addressed. Specifically, ED physicians used their medical knowledge and experience with differentiating ‘sick’ from ‘not sick’ patients to detect and identify meaningful ‘figures’ (information delimiting the problem to be solved) against one or more of these ‘backgrounds.’ In an ill-structured problem space such as the ED, awareness of various perspectives on the problem and solution space (potential backgrounds) is likely to provide more situation-specific opportunities to close open constraints in the problem space and increase physicians’ chances of making decisions that are meaningful and beneficial to both their patients and themselves. It is in this sense of *problem restructuring* that “the man whose vision is not limited to the few feet just ahead [i.e., the focal problem], but who directly takes in more distance possibilities as well [e.g., contextual constraints], will most surely and quickly find a practicable path through difficult terrain” (Duncker, 1945, p.39).

Conceptually, assuming a certain perspective in the process of solving a problem (considering the problem against a certain background) separates “the set of all attributes characterizing information structures in the problem space ... into two subsets – essential and inessential attributes” (Reitman, 1964, p. 306). By using multiple, problem-relevant perspectives or ‘backgrounds’ as filters on the total set of information, the amount of essential attributes can be reduced to clues, which are crucial for a particular problem and salient for its solution. Applied to the present findings this suggests that ED physicians used contextual constraints to modulate the ‘degree of salience’ associated with a particular clue (the gain setting), which was then translated into the selection of ‘high gain’ (‘worst case’ heuristic) or ‘low gain’ strategies (‘common-things-are-common’

heuristic). In other words, constraints on the range of potential (medical) problems and corresponding solutions helped ED physicians find a balance between safe and efficient care and a gain setting that satisfies the local requirements for a stable and effectively functioning ED system.

From a theoretical perspective, the above findings reframe how the concept of ‘optimization under constraints’ is interpreted as a particular model of bounded rationality. To account for limited availability of resources, classic models of ‘optimization under constraints’ posit the optimal stopping rule, which contends that search efforts will be discontinued when costs associated with further search start to exceed the benefits of obtaining additional information (e.g., Anderson & Milson, 1989; Sargent, 1993; Stigler, 1961). From a psychological perspective, these models have been criticized mainly because they assume comprehensive knowledge about cost-benefit tradeoffs and vast computational power to perform an infinite regress of cost-benefit calculations (cf. Gigerenzer & Selten, 2001; Gigerenzer et al., 1999). However, the above examples suggest that when ED physicians tradeoff whether or not to make a particular decision (e.g., to order additional medical tests) they can generate a ‘good’ guess about efficient and safe solutions. Moreover, they can do so with reduced computational effort based on their understanding of how the constraints on potential problems and available solutions can be used to shape and delimit the problem to-be-solved. In other words, by taking advantage of these constraints, ED physicians are able to ‘satisfice under constraints’ when they decide efficiency tradeoffs with moderate effort and select strategies with ‘good enough’ outcomes.

In summary, just like biases and heuristics become ecologically rational decision strategies if considered in the appropriate environment, ‘optimization under constraints’ becomes a psychological plausible and efficient mechanism (i.e., ‘satisficing under constraints’) when it is considered that tradeoffs are not only decided in the ‘mind’ but may be resolved by exploiting environmental constraints to delimit the problem at hand. This can be stated more formally by relating ED physicians’ ‘satisficing under constraints’ to Rasmussen’s (1986) knowledge-, rule-, and skill-based cognitive processes. From this perspective, ‘satisficing under constraints’ does not involve exhaustive, normative computation or high-level, knowledge-based processes. Rather, observational evidence suggests that ED physicians make situationally adequate decisions with low computational effort by resorting to lower-level, rule-based associations that have been developed and reinforced through experience with a domain-specific set of constraints (cf. Geertz, 1986; Lave, 1987). In other words, constraints on problems and actions allow the evolution of heuristic short cuts that approximate more normative computational processes in terms of effectiveness but without incurring similar cognitive demands (i.e., they ‘satisfice under constraints’). It is in this sense that ED physicians’ choice of care delivery strategies is ecologically rational.

The above examples of ED physicians’ care delivery strategies have shown that emergency medical care is not provided in a vacuum but in ecologically rich, organizational and social context. As became apparent from examples of constraints on action that pertain to the patient, one particularly important aspect of emergency medicine is related to the essentially social nature of care delivery in the ED. Hitherto, the social dynamics underlying medical practice in general (cf. Roter & Hall, 2006) and

emergency medicine in particular (cf. Hamilton & Marco, 2003) have been largely neglected in the literature on medical decision making. On the other hand, observations confirmed the statement that the practice of medicine is marked by a dynamic interaction between (at least) “The doctor, the patient, and his illness” (Balint, 1955; see also Adler, et al., 2001). Thus, another, separate section seemed warranted to more precisely define the structure of the ED domain (see prelude), which, based on the observations (e.g., Case 26), is ill-structured not only from a medical but also from a social perspective. The following section will further elaborate on the complexities social dynamics introduce in the care delivery process and describe some of the strategies the observed ED physicians used to cope with the ensuing ambiguities.

Part IV: The ‘Hidden’ Social Dynamics of Care Delivery in the ED

Traditionally, the physician’s problem space has been formally defined around the patient’s complaint. The patient’s complaint, however, is only in part defined by underlying pathophysiology, which is the focus of medical training and evidence-based clinical algorithms. Formally, mainstream medical science has hitherto largely neglected that a medical complaint pertains to an individual with complaint-related beliefs, concerns, preferences, and needs (see Adler et al., 2001). Patients own their complaint and a unique perspective on its symptoms and implications for their functioning. They have an experiential history with the complaint and they will (if cured or not) have to live with its consequences in the future. Thus, for patients, the complaint’s relevance is defined by its physical symptoms as much as by its emotional and functional implications for their life and social interactions (Ong et al., 1995). Without conceptually closing open constraints in ED physicians’ problem space by providing a premature definition of

‘good’ medical care (e.g., fixing the physical complaint versus curing versus satisfying the patient etc), it seems that care effectiveness depends on physicians’ ability to recognize, reason about, and address medical complaints in the context of patients’ particular circumstances. To illustrate the informal (hitherto ‘hidden’) but fundamentally important task of incorporating the patient’s perspective in medical reasoning and problem solving, three types of medical problems could be identified in the observational data: Every-day medical problems, ambiguous medical problems, and medical problems with hidden agendas.

Every-day medical problems

Case 28

It is 1:48 pm. A Resident goes to see an 89 year old male patient who fell in his bathroom. At about 9:30 that morning, the patient wanted to throw something in the trash can and lost footing. He used his left thumb to support himself but could not prevent the fall. His whole right side and his left thumb hurt. In addition, the patient was sent in by his cardiologist because his blood pressure was at 188/85; normally his blood pressure ranges at about 110/65. The patient’s wife and daughter decided to call the ambulance because the patient could not move due to the fall and it was difficult for the two women to transport the patient by themselves. The nurse mentions to the Resident that the family wanted the patient to go to another hospital but the cardiologist, who does not practice in the other hospital, sent them here.

The family is in the room sitting next to the patient. Both the patient’s wife and daughter are very concerned. Particularly, the wife feels guilty that she had to let her husband lie on the floor and could not pick him up after he fell. The daughter is concerned about mobility issues and pain management. Her father has difficulty walking, which exacerbated due to the fall. In addition, the patient gets drowsy from pain medication, which makes it even more difficult for the daughter and wife to move and transport the patient.⁶⁶

Resident: Did you feel weak [when you were falling]?

Patient: No.

Daughter: Yes! He is feeling ok but has zero energy!
[the daughter is moving closer to patient's bed so she can follow the discussion better]

Resident: Are you short of breath?

Patient: No.

Resident: Any belly pain, nausea, vomiting, diarrhea?

Patient: No.

Resident: Any blood in your stool?

Daughter: He has dark stool, a very dark brown, like mulch.

Resident: Ok, are you peeing ok?

Patient: Yes.

Resident: Headache?

Patient: *No... I don't know what this ... [trying to get back on topic] I was throwing something and that's why I fell... [the patient's daughter is patting his back]*

Resident: [nodding] Are you walking ok?

Daughter: With a cane and a walker... mobility is a big issue!
Any problems speaking?

Wife: *[slowly getting impatient] No.*
Any confusion?

Wife: No.

Resident: Any medical problems/ surgeries?

Daughter + wife: [enumerating] He had a valve replacement 20 years ago; a quadruple bypass 30 years ago; he has diabetes; prostate cancer; skin cancer; ...that should be all.

Resident: Problems with acid reflux?

No.

Wife: *...but me ☺ [daughter is laughing about her mother]*

Resident: *[without reacting to the wife's joke] How about your thyroid?*

Patient: That's removed.

Resident: Lungs?

Patient: They're ok.

Resident: Any allergies?

Patient: None.

Resident: What meds are you taking?

Patient: I take a lot of them...

Wife: *[Secretly to her daughter] You gave the list to a nurse, didn't you? [the daughter is nodding; the patient's wife is shaking her with respect to what is happening]*

2:08 pm: Physical exam. The patient is still in his clothes (pants and shirt) underneath the hospital gown. It is difficult to get the clothes off:

Resident: I'll cut it right off...

Patient: You're kidding.

Resident: No, I'll cut it.

Daughter: *Can I help you?*

The Resident and nurse undress the patient without answering the daughter's question.

Resident: Is it a pain like it is broken or like you are sore?

Wife: Well, he doesn't know!! *[the wife is shaking her head again]*

Daughter: She thinks it's her fault... *[because she could not pick up her husband]*

Resident: *[no reaction]* Ok, we'll get some x-rays to see what's going on...

The Resident performs a neurological exam on the patient; the patient's face shows signs of pain.

Wife: *He is suffering and awfully sore on his right side, for god's sake!!!*
[the daughter calms her mother down]

Daughter: *How long is this going to take, 2hrs, 1 hr, 20 min?*

Resident: *I guess 30 minutes.* []

4:41 pm: The Attending and Resident in the room with the patient. []

Daughter: The only question I have is 'How can we get him home, in an ambulance? ... or back, if necessary?

Attending: We can arrange for that... another possibility would be a rehab unit for a couple of days... a short term nursing home ... our social worker can check that out...

Daughter + ... or somebody can come to our house and take care of him?!

wife: [The family does not seem to like the idea of a nursing home]

Attending: Sure, the social worker can help you with that...

5:21 pm: The social worker with the Resident

Social worker: The family is yelling at me! She [the daughter] said: *You cannot discharge my father, ask the doctors what they would do if this patient was their parent?* ... He cannot walk or get up! They said they would call the president of the hospital ... I don't wanna go in there anymore... they are irate!

The Resident is back in the room with the patient and his family.

Daughter: He cannot move... there must be something you can do for him here. You cannot just send him home... and I don't want him to take any more pain meds... that will make him too drowsy.

Resident: But he will need some meds so he can be transported ... I can give him a smaller dose, maybe $\frac{1}{4}$ of the normal dose, that shouldn't make him too drowsy. Other than that, we cannot do much for him here... we are mostly concerned about bad things, like a heart attack, and we ruled that out ... they can do more for him in a nursing home.

Daughter: Well... [to her mother and father] ... I guess we have to try and see how it goes... until you get better, dad ...

The daughter leaves the room to make a phone call. She is shaking her head...

It is 5:31 pm: Even though it is past normal work hours, the Resident stays in the ED until everything is setup so the patient can be transported to a rehab institution.

Case 28 clearly shows how the failure of addressing a medical complaint in the context of the patient's (and family's) particular circumstances and needs is ineffective and may hamper problem solution. Initially, the Resident followed protocol and asked questions pertaining to the history of present illness (HOPI) as well as the patient's past

medical history (PMH). However, the Resident did not realize that the patient and his family did not understand why these questions were relevant and that they were concerned about other issues (e.g., the patient's mobility and pain). The Resident was perceived as unresponsive to the patient and family (e.g., the daughter's concern about mobility and drowsiness induced by pain medication), insensitive (e.g., 'He is suffering and awfully sore on his right side, for god's sake!'), and unprepared (e.g., 'You gave the [medication] list to a nurse, didn't you?'). Increasing dissatisfaction with the care received ultimately resulted in the daughter 'yelling' at the social worker: "You cannot discharge my father, ask the doctors what they would do if this patient was their parent?"

Although medically everything that needed and could be done in the ED was provided (e.g., ruling out 'worst cases' and managing pain), the daughter's reaction suggests that the family felt essentially ignored with respect to their situation, needs, and expectations⁶⁷. A solution to the patient's and family's problem (e.g., sending the patient to a nursing home) was finally suggested by the Attending. But this potential solution could not be easily implemented because the family did not like it and apparently interpreted it as an easy way out for the ED physicians ('There must be something you can do for him here ... you cannot just send him home') rather than a well-intentioned suggestion. Thus, the Resident had to try and calm down the family and stay over time to make sure the patient's case could be terminated successfully.

Ambiguous medical problems

Excerpt 12 (based on an email conversation with an Attending ED physician)

You indicated you could use some stories about how the interview process and the 'listening' can often lead to a better diagnosis. And this story is still fresh in my mind – although *similar*

happen not infrequently – where one must think outside the box, after heeding some verbal or physical clue or otherwise going with a gut feeling that something isn't standard.

Wife brings her husband in, about 55 years old or so. She is very upset. He was just released from the hospital a week earlier with the same problem. She felt she had been given no good answers (perhaps *a bit 'brushed off'*). He has cirrhosis of the liver for no known reason (never drank alcohol in his life). He is now in advanced stages and his ammonia level was found to be up (77 with a normal high of 55). He was given the usual treatment with increased doses of lactulose and sent home after a few days – only modestly improved.

It was a particularly busy shift, *but I saw I would need to sit with this woman* (and her husband, but he wasn't in any shape to speak) just to let her vent if nothing else and to affirm the legitimacy of her concerns. *In doing so (spending way more time than normal for such a complaint) I was able to come up with a wholly different theory* of why he was having these problems. [] *it got us (as physicians) off the same well-worn path that was leading to nowhere in this case. And the patient's wife was satisfied at this beginning to look at her husband as an individual* and not just another case of hepatic encephalopathy []

Perhaps this type of story – where *just looking and seeing a gray patient and ordering an EKG won't really cut it* – is what you want to demonstrate that *allowing the patient or family member to lead you to the answer is sometimes necessary*.

Excerpt 12 is taken from an email conversation with an Attending ED physician, which focused on the importance of 'listening' to a patient. The excerpt describes a medically ambiguous situation where a 'common-things-are-common' rule such as 'seeing a grey patient and ordering an EKG won't really cut it.' Specifically, the patient 'was just released ... a week earlier with the same problem' but with 'no good answers' to his problem. Moreover, the patient had 'cirrhosis of the liver for no known reason (never drank alcohol in his life).' Given this unclear situation the Attending physician 'saw' that – instead of following 'the same well-worn path that was leading to nowhere in

this case’ – it was necessary to take time for this patient and letting his wife ‘vent’ and tell their story even though ‘it was a particularly busy shift.’

This example describes how an ED physician integrated information over a patient’s medical history and personal experiences with a medical complaint to select a situationally adequate and effective evaluation strategy (‘I saw I would need to sit with this woman ... to let her vent if nothing else’). More specifically, in Excerpt 12 the patient has been ‘perhaps a bit brushed off’ indicating that the patient wanted to provide important information but was not able or allowed to do so. Thus, in situations where information might have been missed during a previous patient-doctor encounter, ‘listening’ and ‘allowing the patient or family member to lead you to the answer is sometimes necessary’ and ‘can often lead to a better diagnosis.’ That is, in the experience of this ED physician, taking more time to ‘listen’ to patients and their relatives may change the problem from ‘following the same well-worn path’ to the selection of situationally adequate evaluation strategies, particularly in medically ambiguous situations.

Medical problems with hidden agendas

Excerpt 13:

A Resident and a physician assistant (PA) talk about their patients.

Resident: Vain, needy, mean people here today.

PA: Feels like it. I only see those and I’m telling them: No, I can’t just give you Vicodin⁶⁸ ... odd people today.

Resident: I have a Crohn’s disease⁶⁹ patient. She didn’t indicate pain when I was using the stethoscope to listen to her belly, I was pressing real hard ... she showed signs of pain only afterward when I was using my hand. *You should know how to play it.*

Excerpt 13 provides a short example where certain behaviors-symptom combinations point to an ED patient with a hidden agenda. Particularly, in their conversation the Resident and PA refer to patients who come to the ED and pretend to be in physical pain to obtain potent narcotics. In these cases, it may be important for a physician to uncover a patient's *real* intentions and avoid the unwarranted administration of pain medication, which is costly and potentially dangerous for the patient. For example, in the case of the Crohn's disease patient described by the Resident, the patient involuntarily revealed her bogus complaint because she didn't 'know how to play it' and mimic the symptoms of a patient who is actually experiencing physical pain in the abdomen. In general, examples such as those in Excerpt 12 indicate that it is challenging for ED physicians but essential to efficient care delivery to recognize the *real* intentions of "the complaining patient, the pain medicine seeking patient, the vague patient, the non-communicative patient, the frequent flier patient, the obtunded patient, the patient with many busy-body relatives, etc" (Kwiatek, personal communication, January 7, 2009).

When social context matters: The challenge of creating 'common ground'

Reason is, within its own domain, highly pragmatic and beneficial, yet it is primarily restricted to the linear domain ... therefore, logic adds factual, useful information but does not provide complete meaning as such ... While linearity denotes characteristics of definition and identification of factual qualities, 'meaning' is a consequence of essence and context. (Hawkins, 2008, p. 336)

The unfortunate example about an 89 year old patient with thumb and rib fractures (i.e., Case 28) suggested that medical care alone may not satisfy patients' needs and sometimes a physician's emphasis on medical facts may even hamper effective and

timely care delivery. Already Hippocrates mentioned that the effectiveness of medical treatment may be supplemented by the fact that “the patient, though conscious that his condition is perilous, may recover his health simply through the contentment with the goodness of the physician” (Hippocrates, 400 BC/1923). More recently, it was Peabody (1927/1948) who stated that “the secret of the care of the patient is in caring for the patient” (p. 552) and Balint (1955) who similarly posited that it was “not only the medicine ... or the pills ... that mattered, but the way the doctor gave them to his patient – in fact the whole atmosphere in which the drug was given and taken” (p. 6866). With respect to Case 28, a simple question at the outset about the patient’s and family’s needs and preferences may have prevented the family’s outrage, probably shortened the patient’s stay in the ED (the patient had to stay more than 4 hours in the ED), and saved extra work, time and resources for the physician and the ED.

Excerpt 12 in this section about a patient presenting with an ambiguous set of symptoms, suggests that there is another benefit to ‘listening’ to patients and/or their families (i.e., establishing rapport with the patient). Specifically, Excerpt 12 suggested that by listening and letting the patient (or relative) tell his or her ‘story,’ ED physicians may be able to obtain relevant information (‘the missing link’) about a patient’s problem. That is, information provided from the patient’s perspective may help the ED physicians develop a more comprehensive and detailed understanding of the medical problem and ultimately, select strategies that are adapted to and therefore highly effective to solve the case at hand (i.e., ‘In doing so (spending way more time than normal for such a complaint) I was able to come up with a wholly different theory’). In other words, an understanding of how an (ambiguous) medical problem relates to the patient’s personal

life and circumstances may help ED physicians decide how emergency medical resources can be best used to address the patient's medical problem.

Finally, Excerpt 13 has shown that in social environments such as the ED, the problem space includes the problem itself (i.e., the disease of the patient) but also the interaction partner(s) (e.g., the patient, the family, nurses, consultants) as 'motivated tacticians' who are functionally adapting behavior according to their agenda and environmental opportunities (e.g., Adler et al., 2001; Fiske, 1992). This suggests that ED physicians' problem space is ill-structured in two ways. As stated in the prelude above, the *formal definition and solution of medical problems* is marked by 'open constraints,' which requires ED physicians to delimit problems that are workable in the ED. Strategies to do so effectively by (re)structuring problem and solution spaces have been described in Parts I-III of this section.

At the second level, it has been recognized in the literature on patient-doctor communication that the patient-doctor relationship is characterized by information and goal asymmetry (Ashworth, Longmate, & Morrison, 1992; Charles, Gafni, & Whelan, 1997; 1999). Actors involved in the care process – physicians, patients, family, and ED staff – may refer to the same problem but do so in the context of their particular concerns and relevant areas of interest. From a social science perspective, the negotiation of 'common ground' between two (or more) actors (Clark & Brennan, 1991; Clark & Schaefer, 1989) or the "recognition of a common area of relevance is a prerequisite of agreement" on what a social encounter is about (McSweeney, 1973, p. 149). In turn, an agreement on what matters and what needs to be done in a particular situation forms the basis for meaningful communication and coordinated action. In other words, the social

dynamics involved in the practice of emergency medicine add another ‘*hidden*’ (i.e., *informal*) level of ambiguity and ill-structure to ED physicians’ problem space. The following section will discuss strategies ED physicians used during the observations to cope with the complexities introduced by the social dynamics underlying the practice of emergency medicine.

The benefit of caring for the patient: The challenge of rapport

Previous examples have shown that ‘common ground’ between physicians and patient is not a given in the ED. From the physicians’ side, not every patient is able or willing to provide ‘useful’ input, especially in the ED. Patients may be ashamed to say or even be trying to hide why they came in to see a doctor or they may be outright lying to obtain drugs or other ED services; patients may be aggressive and uncooperative; or patients may be confused or not able to communicate due to impending medical problems. From the patients’ side, studies have shown that although patients generally like to be informed about their disease and possible treatment options, most patients do not explicitly demand this information let alone take initiative to participate in the evaluation and treatment process (e.g., Elwyn, Edwards, & Kinnersly, 1999; Roter & Hall, 2006). Thus, patient input and information sharing are not a given but have to be acquired.

Recent investigations into how therapeutic relationships impact patient behavior have indicated that autonomy supportive “communications enhance patient participation in the medical visit’s dialogue, contribute to patient engagement in problem posing and problem-solving, and finally, facilitate patient confidence and competence to undertake autonomous action” (Roter, 2001, p. 17). Particularly, it has been suggested that listening without interrupting (e.g., Charon, 2001), asking open-ended questions, responding to

emotional needs (Halpern, 2001; Suchman, Markakis, Beckman, & Frankel, 1997), and sincere concern help patients disclose personally sensitive information via increased rapport and trust (DiMatteo, 1979; Roter, 2001; Roter & Hall, 2006). In addition, asking patients for their input, feedback, and expectations (Engle, 1988) and providing them with easy-to-comprehend information about the medical problem and possible treatment options may work to increase “patient activation in agenda setting, information-seeking, reflection, problem-posing and joint problem-solving” (Roter, 2001, p. 22).

This suggests that to avoid miscommunications and misinterpretations with respect to patient’s medical problems but also their personal needs and intentions, ED physicians have to acquire and negotiate mutual understanding or ‘common ground’ at a socio-emotional level. The psychosocial equivalent to the cognitively defined concept of common ground is *physician-patient rapport*⁷⁰, which has been mentioned in the social psychological literature (DiMatteo, 1979). Rapport in this sense has been defined as the “concern for and empathy toward the patient ... to satisfy their socioemotional needs in the health care encounter” (p. 12). This line of research has associated communication processes that emphasize empathetic concern with improved patient cooperation, satisfaction, and treatment outcomes (e.g., Roter & Hall, 2006). Based on Self-Determination theory (e.g., Deci & Ryan, 1985), the positive relationship between certain communication behaviors (e.g., offering choice, acknowledging feelings) and the facilitation of autonomous health behavior has been demonstrated in several empirical studies (e.g., Williams, Freedman, & Deci, 1998).

Patient -> physician communication

“...listening to the patient and not the text [book] is, I think, key.”

Taken from a conversation with an experienced ED physician

Case 29

7:16 am

A Resident and an Attending discuss the case of an 89 year old female patient who came in with a complaint of back and shoulder pain. The pain had started the night before and was radiating to the front when the patient woke up. Now, the patient is concerned about a heart attack. The patient has a history of heart and lung disease and is chronically anemic.

Attending: Maybe it's shingles

Resident: That's my suspicion. She had it before on her leg. It may well be that shingles become visible in 24 hours.

Attending: [] that's something to consider. But I would probably go ahead and do the chest work up. Is she a d-dimer candidate? It sounds pleuritic ... let's order it, she is 89, it could a number of really bad things ... and don't forget her digit [digoxin⁷¹] levels. She is a digit patient.

7:49 am

The Attending is back at the physicians' station after talking to the patient.

Attending: [to the Resident] If I had to bet my money on it, it would say it's shingles. I talked with her family on the phone, they are really nice. They said that she [the patient] gets really scared about back pain because one of her relatives complained of back pain and died from a Heart Attack. I would probably send her home with follow up but if anything is off, take her in for obs[ervation] for a day.

9:15 am

After having talked again to the patient, the Resident reports to the Attending.

Resident: She thinks she needs some blood again [the patient is chronically anemic].

Attending: *Let's just put her in. Call the [admission physician for the pulmonary group]. Would have been nice if she had told us 2 hours ago. That would have made it easier.*

Attending: [to the observer] Do a study on patients telling us things in the first 45 minutes. I'm real nice and chatty ... and they still don't tell me.

Case 29 provides a good example of how early input from the patient may improve care delivery effectiveness with respect to the categorization of 'sick' (to be admitted) versus 'not sick' (to be discharged) patients in the ED. Specifically, the patient came in with back and shoulder pain and a concern for heart attack ('she gets really scared about back pain'). Given the patient's complaint and age, the physicians evaluated the patient for heart issues and other 'worst cases' ('it could be a number of real bad things') but actually suspected the patient to be 'not sick.' That is, the Attending associated the patient's complaint with a recurring episode of shingles (in the physician's experience, a 'common thing' with respect to the patient's complaints and previous history) and intended to 'probably send her home with follow up.' On the other hand, given the patient's concerns and age, the Attending suggested that 'if any [test result] is off' the patient should stay in the hospital 'for obs[ervation] for a day.' In other words, the physicians had to go through and wait for elaborate evaluation procedures to come back before a final disposition decision was possible.

This situation changed when the patient, who was chronically anemic, stated that she may need 'some blood again.' Based on this *new* information, the Attending decided immediately to 'just put her in' without waiting for more test results to come back. This suggests that early input from the patient may improve ED physicians' ability to identify relevant contextual constraints that may facilitate situationally adequate and effective

decision making ('Would have been nice if she had told us two hours ago. That would have made it easier'). With respect to the ideal of 'patients telling us things in the first 45 minutes,' there were several strategies the observed physicians used at different stages of the care delivery process to increase the chances that their patients feel comfortable and speak more freely about their concerns and preferences.

Excerpt 14

I think the secret [to effective emergency medicine] is good preparation before the patient encounter. I tend to prepare ahead: What's their issue, what meds do they take, what's their [medical] history ... all that you can find in the [hospital's computer] system. They get really mad if they get asked the same questions for the 5th time... do you have chest pain? Yes; since 5 days? Yes ... I go also in asking direct questions first: 'Where is the pain exactly? What does it feel like?' ... that makes them feel like we know what we're talking about. In the end, I open it up and ask open-ended questions like 'Is there any other pain you're feeling?' [] I reevaluate rather than stay too long, I see them more often. After that, it's all about efficient prioritization. The first question is 'sick' or 'not sick.'

Helping patients share information. Excerpt 14, taken from a conversation with an experienced ED physician about the 'secret' of effective emergency care, suggests that a '*good preparation before the patient encounter*' is a prerequisite to 'efficient prioritization' and the categorization of patients as 'sick or 'not sick.' In general, Excerpt 14 suggests that an effective interaction style aims at inducing and maintaining a good working relationship with patients. One function of good preparation is to *not* make patients 'mad' by unnecessarily repeating standard questions with already known answers. A second part is to increase trust in physicians' competence and make the patient feel 'like we know what we're doing' by asking targeted questions. Open-ended questions, on the other hand, and short, repeated visits may help physicians get at

additional, hitherto 'hidden' information. The next Case will provide an example of how open-ended questions can increase the chances that patients and their family share their (often helpful) insights and concerns.

Case 30

A resident goes to see an 80 year old male patient with chest discomfort [as per triage note]. The patient also complains about shortness of breath and a stuffy nose.

Resident: How long are you having these problems?

Patient: For about one day.

Wife: [to the observer] He is not breathing right since 4-5 days.

Patient: It hurts on top of chest

Wife: [to the observer] Also in his arm [shaking her head].

Resident: Did you have this pain before?

Wife: [to the Resident] Yes, he did.

Resident: Did you have a heart attack before? [patient is nodding] Is it the same pain?

Patient: It's different.

[]

Resident: I don't think it's your heart but we have to do some tests to be able to say for sure. It could be a cold or pneumonia.

Wife: [whispering to the observer] He is always tired, short of breath, and yawning a lot. He has been eating less.

Resident: I'm gonna give you a breathing treatment. [palpating legs] We are going to look at your heart, that's always a worry. It may be broncho constriction ... with all the post-nasal drip. You are a little old for allergies but that's possible, we'll try to figure that out.

[] *Is there anything else I need to know?* [looking at both the patient and his wife]

Wife: His arm hurts as well. *I didn't want to speak up. I know you might get upset with me* when I interrupt you all the time.

Resident: No, *that adds something. Now it sounds more like cardiac.*

Case 30 illustrates how a simple, *open-ended question* ('Is there anything else I need to know?') can provide patients and their families a chance to share their insights and concerns with the physician. In this case, the patient's wife 'didn't want to speak up' to not upset the physician. However, the wife's input provided the Resident with additional evidence, which transformed an initial 'common thing' impression about a benign medical problem ('I don't think it's your heart ... it could be a cold or pneumonia') into a more cautious attitude about a 'worst case' ('Now it sounds more like cardiac'). Thus, ED physicians' ability to make patients and their families feel comfortable sharing their concerns and insights may prove relevant not only in terms of care delivery effectiveness (see Case 29) but also be vital in guiding medical judgment and, based on a more accurate and comprehensive understanding of the complaint, the selection of adequate 'worst case' or common-things-are-common' heuristics. The next Cases will provide examples of strategies ED physicians used to make their patient feel more comfortable.

Case 31

An Attending goes to check on a 69 year old patient who came to the ED with a complaint of diarrhea, fever, chills, and fluid in a recent incision wound. The patient is visibly disappointed with the care she received previously.

Patient: They didn't take a culture of my urine as they were supposed to. I was on antibiotics and the urinalysis was clean.

Attending: Maybe it's a partially treated UTI [Urinary Tract Infection].

Patient: I had a fever again and fluid in my wound ... I thought that's enough to be worried so I came back in.

Attending: You did the right thing. We will try and get to the bottom of it ... [the Attending is joking with the patient in private].

Patient: [the patient is laughing] You're nice. *I can really use that now.*

Attending: [while leaving to the observer] *You have to listen and let them talk to you. It often helps if they can talk about things.* Most patients get better despite the best medical care ... and you have to make sure they are ok with your decisions.

Helping patients feel comfortable. Case 31 provides an example of how humor and an understanding attitude may relax a patient who is frustrated ('they didn't take a culture of my urine as they were supposed to' and 'that is enough to be worried') and make the patient who 'can really use that now' feel more comfortable (cf. Wender, 1996). More generally, the physician suggested that 'you have to listen and let [patients] talk to you [because] it often helps if they can talk about things.' The next Case provides an example of how and why ED physicians make sure their patients are OK with their devised care delivery strategies.

Case 32

An Attending goes to see a 61 year old male patient. The patient's son tells the Attending that his father was kept in a different hospital for 7 days because he couldn't breathe on and off and blacked out once. The patient's chest hurts and he is coughing up yellow-greenish mucus. The patient has lots of stress at work and comes in with a blood pressure of 194 over 119.

Attending: We should order a couple of tests, probably multiple. This is the deal: 1. For sure, your smoking causes problems; 2. If you're suddenly short of breath and then better, that suggests to me a panic attack; 3. Coughing up yellow-green stuff may be related to an infection. We will order a d-dimer. That is a test to make sure you have no clot in your veins. The respiratory folks will come and give you breathing treatment. We will also get an arterial blood gas... If the oxygenation is ok, it's more evidence for an anxiety issue. I could also be pneumonia or bronchitis so we will get an x-ray, I will give you some antibiotics to treat infection. And we will check your heart ... make sure there is no fluid accumulation.

Patient's son: Can you make sure he is staying in the hospital for a day or two? He will probably work otherwise.

Attending: We will see what we can do. [to the patient] *Are you OK with the plan?*

Patient: OK doc. *Sounds good to me*, I want to get back to my customers.

Patient's son: Thank you so much, chief!

Attending: We will get back and figure out if you A: Need to stay and B: How we can make you breathe better. [while leaving to the observer] *Lots of anxiety in that room ... they were already dissatisfied with the care in one hospital.*

Case 32 provides an example of why, from a social perspective, it is important to make sure the patient (and family) is OK with medical decisions. From the example it is obvious that the physician takes time to provide the patient and his relative with an elaborate explanation of clinical impressions and corresponding evaluation strategies. The Attending's comment to the observer suggests that the physician's effort at explaining the evaluation plan was not without a purpose. Specifically, by explaining in detail what to check for and why, the physician tried to appease the patient and his son who 'were already dissatisfied with the care in one hospital.' Moreover, the physician used social and psychological insight (empathetic understanding) to adequately address the 'anxiety in that room.' This example also speaks to the fact that not only patients should 'tell us things within the first 45 minutes,' but also physicians should tell their patients about their concerns and decisions. The following Case provides an example of another potential benefit of using empathetic understanding and providing patients with explanations.

Physician -> patient communication

“...you must treat the patient like a human and discuss what you are doing 'to them' (so that it becomes 'with them'). Seems so elementary.”

taken from a conversation with an experienced ED physician

Case 33

An Attending goes to see a 94 year old female patient with a previously broken foot. The patient's daughter brought her in because she didn't use her walker and fell. The resident had worked her up for fractures but x-rays came all back negative. The patient seems 'on top of things' despite her age.

Patient: What's up? [mischievously]

Attending: You tell me? [smiling at the patient]

Patient: I don't want a walker until I'm old... [defiantly]

Attending: But the walker will help you keep the balance and take the weight of your foot... for your foot to heal, it's better to not put any weight on it.

Daughter: See, I told you... it will help you get around.

Attending: That broken bone doesn't heal easily so I would also like you to get follow up with an orthopedic surgeon... he'll know what to do if it's not getting better.

Patient: Well, if three people are smiling at me like that, how can I say no? ... That's not fair.

Attending: It will help you get better soon and once the fracture is healed you can see if you can walk again without the walker.

Patient: Well, ok then... I'll try it.

Daughter: Thank you, doctor! I really appreciate your time.

The patient thanks the Attending, points with the finger at the observer and says:

Patient: Thank you, too! You convinced me with your smile. [the patient is smiling]

Helping patients participate in the care process. Case 33 describes a situation where both physician and patient immediately established 'common ground' and a good inter-personal relationship. The patient enjoyed joking with the physician who was

smiling at her. On the other hand, the physician realized that the patient was concerned about her mobility. Thus, the physician explained why using a walker is necessary to help the patient to get well soon (it's better to not put any weight on it ... that broken bone doesn't heal easily) and be able to 'walk again without the walker.' By taking time to talk to the patient and explain what the problem was, the physician could get the patient to agree to use a walker (for the impact of patient-doctor communication on compliance see Roter & Hall, 2006), which the daughter seemed to have tried unsuccessfully ('See, I told you ...'). More importantly, both daughter and patient were satisfied with the care they received ('I really appreciate your time' and 'You convinced me with your smile').

Helping patients understand what is possible in the ED. The following example is based on a set of observations involving 'drug seeking' patients and physicians' pain management decisions. Usually, ED physicians hesitate to administer potent and highly addictive analgesics such as Morphine or Dilaudid⁷², particularly to patients who have a history of drug abuse or present with a (potentially bogus) complaint that does not justify the administration of strong pain medication. A common example of ED physicians' reaction to such patients and their pain management decisions is reflected in the following discussion between a Resident and an Attending physician about a patient with fibromyalgia⁷³ and a facial rash.

Case 34

9:13 pm: The Resident reports on a patient with fibromyalgia and a facial rash:

Resident: She has fibromyalgia and a big red rash in her face ... it looks real bad! She wants Phenergan⁷⁴ and Dilaudid IV. She has a long list of allergies ... sulfur?! I know a lot of people are allergic to antibiotics but the rest [of her list]... she takes a mood stabilizer ... she is bipolar ... Alexia for anxiety and fibromyalgia ... she's an odd duck ... and she asked me how old I was. You don't ask that if you are in pain ... she had 5 surgeries in the last couple of months.

Attending: I know what's going on with this patient. Get basic labs for her: BMP, CBC, give her steroids and Benadryl [an antihistamine that is used to treat allergies]. We won't reward her with a big Dilaudid dose ... not for fibro[myalgia] ... I'm sorry but I'm not a dummy! Her fibro is more a manifestation of depression ... there are very strict criteria for fibro... few people meet it... and most often it may be a manifestation of another disease. Treat her for an allergic reaction and tell her [] she should talk to her PCP about the [relationship between her] rash and her fibro and maybe a change of meds ...

10:20 pm

Attending: Is she feeling better after her meds? []

Resident: She is playing 'poor me.' Her nausea is better but she wants her pain gone...

Attending: [as if talking to the patient] Go home and take your meds. I will talk to her...

Resident: [to the observer] This Attending has zero tolerance for that kind of crap.
[]

Later at the physicians' station after talking to the patient:

Attending: If she feels better with what she got, just cancel her labs. [] If the labs are drawn and sent: Wait. If not: Cancel them. She is fine with going home and following up with her [primary care physician].

Case 34 illustrates two aspects of physician -> patient communication in the ED.

First, physician -> patient communication is a continuous and dynamic process. Second, effective physician -> patient communication does not "simply mean that everyone is in a

state of cosy agreement ... [but] may well involve a great deal of straight talking” (Ashworth et al., 1992, p. 1432). Based on the Resident’s report, the Attending ‘know[s] what’s going on with this patient’ by grasping the patient’s concerns (i.e., ‘She has fibromyalgia and a big red rash in her face’) and ‘area of interest’ (i.e., ‘She wants Phenergan and Dilaudid IV’). However, from the Attending’s medical perspective, the patient’s expectations and needs are unwarranted and require some ‘straight talking,’ first via the Resident (‘I’m not a dummy ... treat her for an allergic reaction’) and later, with the patient still insisting on pain medication, in person. Of course, there is a fine line between recognizing and addressing an individual patient’s true concerns and ‘areas of interest’ and simply relying on past experience with a particular (type of) patient (for a summary of biases in ED physicians’ decision making see Croskerry, 2002). The next Case provides an example of a strategy ED physicians use to resist confirmation bias.

Maintaining a mindful/cautious attitude

Case 35

1:14 pm

Nurse: She is not gonna stay.

Resident: We’re gonna do a fem line on her.

Nurse: I wonder where all that fluid is coming from... she must have been drinking ...
I think she is gaming it. She is here a lot.

Resident: Maybe... []

2:23 pm: After the initial evaluation and physical exam

Nurse: What, she denied cocaine use? Her drug screen will be positive.

Resident: Probably, but it doesn’t matter ... she was puking.

Nurse: I can put my finger in my throat, too.

Resident: She did it [the puking] in front of me.

Nurse: Oh, really?

Resident to the Observer:

Resident: *Even a regular [ED patient] can get sick ... the thing is you don't believe them anymore.*

3:00 pm

Charge Your patient in 41 gets transferred to 46... the patient and her husband nurse: requested it... the nurse didn't give the meds on time.

Nurse: Her BMP is completely normal.

Resident: What about her White Count⁷⁵?

Resident to the Observer:

Resident: Her BMP is not back yet ... *always be suspicious.*

3:11 pm: The Resident reviews the labs for this patient.

Resident: She has a White Count of 16.1 [values from 5.0 to 10.0 are considered 'normal']

Case 35 illustrated how a preconception about a familiar patient ('She is here a lot') can bias attitudes toward a patient ('she is gaming it') and ultimately care delivery ('the nurse didn't give the meds on time') despite contradicting evidence (i.e., the patient was not pretending to be sick but puked in front of the Resident). This is a classic example of what has been identified as confirmation bias in the literature on medical decision making (e.g., Croskerry, 2002, 2003). As Todd and Gigerenzer (2007) pointed out, such biases are due to a misfit between mental heuristics (e.g., Recognition heuristic: I have seen this patient before -> she was always here for drugs -> therefore she is here for drugs again) and the current structure of the environment (i.e., this time, the patient is really sick).

This example confirms the above statement that, in social environments such as the ED, the problem space includes the problem itself (i.e., the disease of the patient) but

also interaction partners as ‘motivated tacticians’ who adapt their behavior based on their need(s) and environmental opportunities (e.g., Adler et al., 2001; Fiske, 1992). Thus, to create and maintain ‘common ground’ ED physicians have to be mindful/cautious about their patient’s medical and personal needs and ‘always be suspicious’ about their own (and others) understanding of the situation (e.g., Epstein, 1999; Langer, 1989; Langer & Moldoveanu, 2000).

Limitations of physician-patient rapport

Case 36

10:39 am: A Resident goes to talk to a 31 year old female asthma patient that she will be discharged with follow up.

Resident: Do you need a note for work? I would say you should take a couple of days off to recover.

Patient: I’m working at McDonalds... maybe till Monday?

Resident: Ok. I’ll give you a script for 5 days of Prednisone, Albuterol, and a steroid inhaler. *I’ll call to find out if I can find a cheap one [inhaler] because you have no insurance.* You should inhale Albuterol every 4 hours until you get better.

10:51 am: The Resident calls up pharmacies in a local grocery store chain to see if they have a cheap steroid inhaler for the patient.

Resident: *Silly but...* [the Resident searches phone numbers online] ... *a waste of my time. She may not go to this store. I could have asked her...* [the Resident keeps charting while trying to contact a pharmacy] ... *there is probably not gonna be a cheap steroid inhaler.*

11:09 am: The Resident terminates the search for cheap steroid inhaler, unsuccessfully.

Resident: There is no cheap version [] she will have to make a choice between meds and cigs.

There are 3 different prescriptions for inhaler [\$90; \$100; \$120]. The Resident selects the cheapest and prints out the number of the hospital’s physician referral system.

Case 36 provides an example of rapport-inducing behaviors, which are used in a non-functional way. Specifically, the Resident told the patient ‘I’ll call to find out if I can find a cheap [inhaler]’ because the patient had no insurance. Calling the pharmacy was well-intended. However, confirming that ‘there is probably not gonna be a cheap steroid inhaler’ cost the Resident about 20 minutes, which was spent on a task largely unrelated to the success of the care delivery process (i.e., ‘a waste of my time’). A prescription for the cheapest inhaler and telling the patient in a supportive way that ‘she will have to make a choice between meds and cigs’ would have yielded the same result and may have potentially empowered the patient to act on her own behalf and health.

Thus, although rapport-inducing behaviors may be genuine and well-intended, if they are not functionally related to the care delivery process in the ED, they incur additional work without adding value to the care process. The following Excerpt epitomizes the downside of rapport-inducing behaviors that are functionally unrelated to the practice of emergency medicine. It is taken from a conversation between two attending physicians concerning a widely used type of patient satisfaction ratings (the Press Ganey score⁷⁶). In the course of their discussion, Attending 2 displays her opinion about satisfaction ratings as a measure of care quality using her experiences with ‘the worst you can imagine’ resident.

Excerpt 15

Attending 1: It [the Press Ganey score] is only obtained from admitted patients. They are usually the happiest. Discharged patients don't get in ... and if you don't give Percocet⁷⁷ ...

Attending 2: Press Ganey sucks... there was a resident, 15 years ago ... he was the worst you can imagine ... and the first resident to be kicked out of the program. But he had letters written by patients that he was the best doctor ever.

In a later discussion with Attending 2 it was clarified that this resident was trying to get the attention and good will of his patients but, at the same time, was medically not savvy to provide them with adequate medical care. This suggests that an overemphasis on personal relations, if divorced from task-related (medical) knowledge, hampers effective care delivery just like exclusive reliance on medical knowledge may treat the pain while missing to meet the patient's actual needs (see Case 28). It follows that "although caring and [medical] competence may be measured and modified differently, they must coexist" (Elasz, 2006, p. 147). Specifically, observations in the ED suggest that to support care delivery effectiveness both medical and non-medical factors have to be functionally integrated into the problem definition underlying the care delivery process.

The ecological (ir)rationality of physician-patient rapport in the ED

"Virtue is its own reward" in that it precipitates more beneficial outcomes with much less effort. (Hawkins, 2008, p. 68)

Excerpt 16:

The problem in the ED is that there is *often no time for the talking part* and so we tend to jump to the labs to get the answer. *Fair enough - it usually will work* (and with the non-talking patient there is of course no other choice). But the non-standard cases are tougher if you haven't talked to the patient (or listened to them) ... and either way, you don't have the patient traveling with you down the diagnostic path, and even if you are more or less right in your treatment, if you've left the patient behind, you have an unhappy customer. [] I have found that spending a precious few moments with patient and family and trying to hear what they are saying to you can help to *overcome many of the obstacles* because that is where you pick up clues as to *what the patients' concerns are* [] Even if you fail - *you have the patient and family on board* and buying into the direction or plan - and this if nothing else can be a guide to the next steps - usually done away from the emergency department (not to mention they can prevent lawsuits).

Excerpt 16 helps to summarize the findings provided by the above evidence, which suggests four main findings with respect to physician-patient rapport. First, medical skill may be sufficient ('... we tend to jump to the labs to get the answer. Fair enough – it usually will work'), but good rapport can enhance patient satisfaction and care efficiency, particularly with ambiguous cases. Second, rapport helps physicians elicit better information from the patient in that the patient feels comfortable to share personally sensitive data ('... spending a precious few moments with patient and family ... can help to ... pick up clues as to what the patients' concerns are'). Third, quality information results in improved 'common ground,' which helps physicians come up with more accurate first hunches about the patient's problem as well as care strategies that adequately address patients' (and families') concerns and preferences. In turn, if needs are recognized and addressed (even if refused in an adequate way), rapport between patient and physician is likely to increase in the form of enhanced understanding, trust, and ultimately compliance ('even if you fail – you have the patient and family on board'). Finally, as suggested in the previous section, rapport alone is not sufficient. That is, it must be coupled with effective medical skill for it to lead to satisfactory outcomes.

Satisficing in the ED continued: The common ground-rapport dynamic. ED physicians' problem space is formally defined from the perspective of specialized medical knowledge and biomedical research evidence. However, the medical domain does not consist of medical professionals only. Patients and their family often have a different perspective on their 'medical' problems and idiosyncratic concerns including the complaint's emotional and social implications (e.g., DiMatteo, 1979; Ong et al., 1995; Roter & Hall, 2006). That is, ED physicians' problem space is characterized by a

fundamental goal and information asymmetry between the actors involved in the care delivery process (Ashworth et al., 1992; Charles et al., 1997, 1999).

Excerpt 17

“...the nice coincidence is that in doing the 'caring' part, you will end up doing a better job on the [medical] 'care' part - because you will have partnered with the patient who probably has the answer to the [medical] 'care' piece, if you'll just let him/her share it with you.”

Excerpt 17, taken from a conversation with an experienced ED physician, summarizes the central findings of this section. That is, the dynamics between physicians' ability to listen to the patient (to let him/her share it with you) and to care about and for the patient (the 'caring' part) helps physicians to do a better job in providing medical care (the 'care' part). This statement – reflected in the findings presented above - extends the list of outcomes hitherto associated with caring, empathetic, mindful, narrative medical care into the field of ecologically rational (medical) decision making. Specifically, to the extent a physician manages to create a trusting relationship with their patients ('partner with the patient') and tease out essential information during the interview process ('the patient ... probably has the answer to 'care' piece'), they can capitalize on the social dynamics that characterize the ED domain and fill open constraints in the problem space in a flexible and situationally adequate way. To do so, physicians have to get their patients 'on board' – cognitively and emotionally – so they more readily disclose potentially relevant symptoms and associated psychosocial and socio-emotional data, help the physician develop and maintain an adequate understanding of their problem (e.g., by providing feedback), and even contribute to the problem solving process (Roter, 2001; Roter & Hall, 2006).

Hitherto, it has been suggested that physicians who acknowledge and address patients' symptoms in the context of their psychosocial and socio-emotional implications have more satisfied, more compliant, and healthier patients (e.g., Balint, 1955; Stewart, 1995) but are also potentially more satisfied themselves (e.g., Suchman, Roter, Greene, & Lipkin, 1993). This research extends these findings by suggesting that physicians who create and maintain common ground and rapport with their patients fill open constraints in the task environment to yield an ecologically grounded, patient-specific problem space. Instead of relying on a collection of physical symptoms alone, such a problem space allows physicians to understand how symptoms impact a patient's life and consequently, how their medical expertise can be put to use to approach the problem.

Conceptually, the dynamic interrelationship between 'common ground' and rapport suggests that they are part of one process of social understanding and that the artificial distinction between these concepts is rather due to scientific departmentalization between cognitive and social psychology than to the phenomenon itself⁷⁸. The presented observational evidence suggests that, in the ED as a specific social setting, there can be no genuine rapport without (some level of) common ground and effective common ground is facilitated by (at least some level of) rapport. In other words, true understanding of human behavior cannot neglect one part of human social existence without failing (or at least missing the point when trying) to understand the other. Similarly, true understanding of medical decision making, problem solving, and expertise cannot be achieved by focusing exclusively on cognitive processes operating on 'formal' medical knowledge (e.g., Barrows & Feltovich, 1987; Croskerry, 2002; 2003; Patel & Groen, 1986; Schmidt, Norman, & Boshuizen, 1990) while neglecting the 'informal,'

though pervasive, socio-emotional connection between patient and physician and its impact on the effectiveness of care delivery processes (e.g., Charon, 2001; Epstein, 1999; Halpern, 2001; Roter & Hall, 2006).

Conceptual Summary of Observational Findings

With respect to the goals of the present study, the empirical data presented above provides a preliminary answer to whether, when, and how ED physician use fast and frugal heuristics in a naturalistic setting (i.e., the *first* goal of the present research). Based on the data, ED physicians possess an adaptive toolbox of at least two general heuristics to cope with the ambiguity inherent in every-day emergency medical problems. Both ‘worst case’ and ‘common-thing-are-common’ heuristics do so by constraining the amount of information (search) necessary for decision making (i.e., they are fast and frugal) and by providing a ‘good enough’ hypothesis to guide action (they satisfice but do not optimize with respect to certain care delivery goals). In Charles Peirce’s words, ED physicians’ heuristics are based on an abductive process, which refers to a “process of forming an explanatory hypothesis” (Peirce, 1931/1994, p. 117) of the possible causes of a (medical) problem (e.g., a ‘worst case’ or a ‘benign problem’) and consequently, for how this particular problem might be solved. This finding adds to the scarce empirical evidence that the use of fast and frugal heuristics extends beyond constrained laboratory tasks and abstract computer simulations. Based on the results of this study, human decision makers – physicians – exploit the power of fast and frugal heuristics to cope with the complexity and uncertainty inherent in a naturalistic decision environment - the ED domain in the U.S.

The overall goal of this research was to understand bounded rationality in the ED. Traditionally, it has been assumed that physicians' task is defined around patients' pathophysiology (Adler et al., 2001). Based on this definition, the success of physicians' treatment was considered to depend on how well they can use their medical knowledge to diagnose and address patients' particular disease processes (e.g., Evans & Patel, 1992; Schmidt, Norman, & Boshuizen, 1990). In the ED, physicians' main concern is not on diagnosing but on effectively dispositioning patients. Moreover, the range of patients' potential diseases (i.e., the problem space) is wide, time pressure is high, and resources to address these problems (i.e., the solution space) are limited so that compromises are inevitable. Under these circumstances, physicians' bounded rationality cannot be comprehensively described as an application of medical knowledge to patients' pathophysiology. Rather, chances for identifying compromises between what needs to be done and what can be done arise out of ecological constraints on medical problems as well as the range of solutions to these problems.

Non-medical influences on medical decision making have traditionally been considered biases and deviations from normative models such as Bayesian inference, which should be avoided to minimize their detrimental impact on the ideal of accurate, effective, and expedient decision making performance (e.g., Croskerry, 2002; McKinlay, Potter, & Feldman, 1996; Nisbett & Ross, 1980). The present findings suggest that it is by exploiting (mostly) non-medical (contextual) constraints that boundedly rational agents (e.g., ED physicians) are able to select sufficiently safe *and* efficient decision strategies with respect to the demands of a complex, naturalistic setting. From a conceptual perspective, these findings add to the hitherto scarce empirical research on

boundedly rational mechanisms people use to decide “which heuristic might be applied when” in complex, real-world settings (Cooper, 2000, p. 746; see also Todd & Gigerenzer, 2007)⁷⁹. From this perspective, the result of Part II and III of this section provide an empirically grounded answer to *when* and *how* ED physicians use fast and frugal heuristics to form and test explanatory hypotheses about patient’s potential medical problems. Figure 3 will be used to address the *second* goal of this study and conceptually summarize the kinds of clues (i.e., constraints) the observed ED physicians’ used to situationally adapt the use of general heuristics given a specific set of ecological constraints on potential problems and possible solutions⁸⁰.

The problem space (the horizontally striped circle on the left) in Figure 3 represents the patient’s range of potential and actual medical problems whereas the solution space (the vertically striped circle on the right) represents the action and solution strategies the ED physician can use to address a patient’s problems.

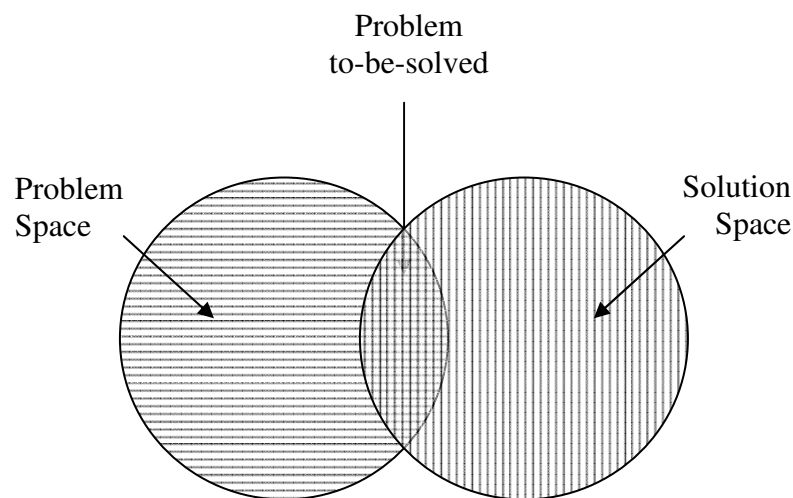


Figure 3. Representation of the relationship between ED physicians’ problem space, solution space, and the problem to-be-solved.

The problem space is comprised of the patient's pathophysiology but, based on the findings of this study, must also contain the patient's psychosocial environment (e.g., family members) as well as socio-emotional needs and preferences. The solution space (i.e., the range of options to disposition a patient), on the other hand, is constrained by how the larger health care system is set up (e.g., the distribution of expertise, the availability of resources), organizational constraints (e.g., limited capacity of Intensive Care Unit (ICU) beds, laboratory capacity), the patient's circumstances (e.g., needs, preferences, social environment), the physician's personal background (e.g., training, knowledge, skills, previous experience with a certain type of disease) as well as immediate situational constraints (e.g., 'the CT scanner does not work today'). The overlap between problem and solution space (the checkered area) denotes the problem to be solved in the ED whereas non-overlapping parts of the solution and problem space represent solutions inadequate for the case at hand or problems irrelevant to care delivery in the ED.

Thus, to perform the abductive process of forming explanatory hypotheses (i.e., identifying the problem to be solved), ED physicians can take advantage of ecological constraints to situationally adapt the size and distribution of the problem space (e.g., in Case 9 the physician suggested to 'do a mini work up ... if she has two to three days of acute sinus symptoms, it's not the heart') and/or the solution space considered for the case at hand (e.g., in Case 25 the attending physician lowered the admission threshold because the patient lived far away from the ED and could not easily come back). In other words, ED physicians' problem and solution spaces are not given in that they shape and determine which heuristic is or is not effective (cf. Gigerenzer et al., 1999; Todd &

Gigerenzer, 2007). That is, ED physicians actively modify both problem and solution spaces based on ecological constraints. By restructuring problem and/or solution spaces, ED physicians can modify the complexity of the problem to be solved and identify which heuristic most likely provides a safe and efficient solution to the problem at hand (for similar arguments cf. Duncker, 1945 and Wertheimer, 1959). It is in this sense that the observed heuristics are ecologically rational with respect to the particular constraints of the ED domain in the U.S. This finding can be used to provide an answer to the *third* goal of the present research (i.e., it describes the degree of ecological rationality of the observed decision strategies).

Limitations and Future Research

One main advantage and the rationale for the use of observational methods was that they provide information about the dynamics of real-world behavior. On other hand, these methods did not allow much control over procedures such as the selection and number of participants (18 ED physicians) as well as observation times. Moreover, observations were performed in two hospitals located in the same geographical region. Study variables such as hospital setting, physician and patient characteristics as well as type of medical problems could not be controlled and may be confounding the observed effects. Although the hospitals were chosen because they differed in terms of size and patient populations, it can not be ascertained to what extent these two hospital settings are representative of other EDs in the U.S., nor to what extent the geographical proximity impacts organizational similarities and differences, which may ultimately impact the solutions space available to ED physicians. Second, the observed physicians at both hospitals were associated with the same physician group (the attending physicians) or

residency program (the resident physicians). This cultural similarity may have diminished inter-individual differences in decision strategies. Third, if a patient or the physician did not wish to be observed, the researcher had to leave the room and/or terminate the observation process. This way, the researcher may have missed potential additional care delivery strategies. Thus, to provide supporting evidence for the impact of ecological constraints on ED physicians' reasoning it will be necessary to perform observations in other hospital settings that are located in different geographical regions in the U.S. and are staffed with a more diverse set of ED physicians.

In addition, one major limitation of this study is that mainly one researcher performed the observations so that data may be biased with respect to the researcher's perspective and only a limited number of observations. Similarly, although data coding was performed by up to 5 different researchers who developed coding schemes cooperatively, the results of this exploratory study are tentative and based on an initial interpretation of the raw protocol data. More controlled follow up studies with multiple observers will be necessary to confirm the presented findings.

Next, with respect to the exploration of the social dynamics underlying emergency care delivery, this study investigated ED physicians' strategies only. Future analyses of the protocol data and future observational studies should focus on a more in-depth investigation of patients' strategies, thoughts, needs, and preferences to complement the present findings. Finally, the study was conceptually broad, not detail-oriented. To gauge the validity and scrutinize the conceptual meaningfulness of the obtained findings, future research should study a specific, more constrained set of

findings in a more controlled setting to provide converging evidence for the observational results.

To circumvent some of the limitations of the observational study, the present research project included a more targeted approach (i.e., a survey study) to follow up on a specific subset of the presented results. Specifically, the survey study focused on the finding that ED physicians' understanding of their patients' needs and circumstances impacts physicians' abilities to identify the patients' medical problems as well as ways to adequately address these problems. The results of this follow-up study will be discussed in the following section.

IV. SURVEY STUDY

The observational part of this study identified and explained the ecological rationality of some of the heuristics physicians use when practicing emergency medicine. Although naturalistic observations provided an ecologically valid description of how ED physicians structure medical problems and their solutions, observational methods cannot effectively disentangle the differential impact of specific environmental constraints on the selection and use of ecologically rational decision strategies. Moreover, based on a limited number of observations (overall 18 ED physicians have been observed in two hospitals), the observational approach cannot provide conclusive evidence with respect to the rate of use of the observed strategies or the existence of further, hitherto unobserved strategies. Thus, the goal of using a second method (i.e., a survey study) to identify ED physicians' decision strategies was threefold. The first goal was to disentangle the impact of specific ecological structures on ED physicians' use of decision making strategies. The second goal was to cross-validate the observational findings from the observational part and quantify the use of observed strategies in a more representative sample of physicians. Finally, the third goal was to broaden the scope of the present study and capture potential alternative strategies that may not have occurred during observations.

Study Rationale

One main finding based on the observational data was that the selection of general heuristics is bound by two major types of environmental constraints. Specifically, ED physicians not only exploit sets of epidemiological constraints to identify patients' probable medical problems (cf. Gigerenzer & Kurzenhäuser, 2005; Wegwarth et al.,

2009) but they also exploit sociocultural constraints on what are considered possible, desirable, and necessary problem solutions. By exploiting both sets of constraints ED physicians are able to delimit the complexity of the problem to-be-solved and identify which of the general heuristics will likely result in appropriate – that is, safe and efficient – care delivery strategies. Moreover, to do so effectively, ED physicians have to cope with additional complexities introduced by the social dynamics underlying emergency care delivery. Observations suggested that ED physicians ascertain quality information about patients’ (medical) problems and acceptable care solutions by creating physician-patient rapport and by maintaining a cautious/mindful attitude with respect to patients’ diverse and changing needs, intentions, and circumstances. Better information about patients’ potential (medical) problems as well as mutually acceptable problem solutions should increase both care delivery efficiency and medical safety.

The construct of mindfulness/mindlessness has been identified as an important factor in creating and maintaining the fit between one’s decisions strategies and the structure of the environment (cf. Epstein, 1999; Langer, 1989; Langer & Moldoveanu, 2000). Mindfulness/mindlessness is associated with the creation of novel distinctions versus an exclusive reliance on categorical thinking; the switching of perspectives versus ‘acting from a single perspective’⁸¹ as well as ‘openness to new ways of doing things’ versus behavioral automaticity (cf. Langer, 1990). Thus, mindful physicians should be better able to pick up on subtle but task-relevant changes in the environment, incorporate contextual changes in their concept of potential problems and solutions, and ultimately make situationally adequate decisions. Apart from a general tendency to be mindful, one specific form of mindfulness in the medical domain is physicians’ ability to respect and

genuinely ‘care about’ patients as individuals who hold a unique perspective on their problem⁸² (Ashworth et al., 1992; Epstein, 1999; Roter & Hall, 2006). If physicians relate to their patients during the interview process, they are more likely to be aware of the patient’s unique perspective (e.g., the patient’s personality), be able to incorporate this perspective in their problem definition (e.g., categorize the nature, severity, and acuity of medical problems), identify acceptable care solutions (e.g., evaluation, treatment and disposition decisions) and, more generally, address the medical problem in a flexible and situationally adequate way.

The finding based on the observational data that social context impacts (biases) peoples’ decision strategies has been identified as a robust finding in social psychological research on conversational effects or contextual influences on judgment (e.g., McCann & Higgins, 1992). Although this line of research has interpreted contextual influences mainly as a potential cause of mental contamination (e.g., errors and inaccuracies, which require mental correction; e.g., Wilson & Brekke, 1994), the present research suggests that ED physicians opportunistically exploit knowledge about contextual factors (e.g., peoples’ needs or personal circumstances) to situate the selection of general heuristics and satisfy the requirements for efficient and safe care delivery. The survey study was designed to extend findings pertaining to contextual effects from a social psychological perspective into the field of medical decision making. To do so, this study focused on the relationship between ED physicians’ abilities to identify potential medical problems and solutions and their social skills at understanding and relating to their patients. Specifically, this study investigated how the perception of a particular patient personality impacts ED physicians’ reasoning and decision making.

V. SURVEY STUDY METHOD

Participants

A convenience sample of 39 resident ED physicians, enrolled in an integrated emergency medicine residency program at a Midwestern public university, participated in this study. Participants reflected different levels of clinical experience. Specifically, out of 39 participants, 14 were physicians during their first year, 12 during their second year, and 13 during their third year of residency. There were 12 (31%) female and 27 (69%) male Residents ranging from 26 to 41 years of age ($M = 31.5$ years; $SD \sim 4$ years). Each of the three experimental conditions had the same number of participants ($N = 13$).

Case Description - Vignette

To be able to identify the impact of patient characteristics on participants' reasoning and decision making, the goal was to use several case descriptions of common but different every-day medical complaints (e.g., abdominal pain, chest pain, altered mental state, or trauma). However, due to time and resource constraints as well as limited availability of participants only one vignette was eventually used. To develop this vignette, ED staff members were asked to 'Tell a story that characterizes an ER physician who is or is not particularly well attuned to the intricacies of emergency medicine as it is actually practiced' (for the contest advertisement see Appendix IV.1). The best story – a story about a stoic patient with an acute myocardial infarction (AMI) who presented with a complaint of nausea and vomiting and only mild chest tightness – was rewarded with a \$50 gift card for a local retail store (for the winning story see Appendix IV.2).

The main characteristic of this vignette was that the physician suspected an AMI early during the care delivery process based on the recognition of subtle physical symptoms (e.g., the patient was ‘a little tight’ in the chest) in the light of minimizing statements by a patient with a stoic personality (e.g., ‘Probably just slept wrong on it,’ ‘I just think I have a bug or something’). In other words, the ED physician depicted in the story recognized that, in the light of a ‘minimizing’ patient, subtle symptoms and hesitant statements may point to more severe symptoms and pathology than the patient was willing to admit. Thus, this vignette seemed ideal to test the effect of patient characteristics (e.g., patient personality/character) on ED physicians’ reasoning and decision making.

For this study, two parts were created based on the original vignette. The first part provided the description of the patient’s complaint and personal characteristics as well as the interview between the physician and the patient. There was no indication of what the physician in the story was suspecting or intending to do for the patient. This allowed probing participants’ decision making, reasoning processes, use of information, as well as their values with respect to the patient and complaint as described in the vignette. The second part provided the physician’s solution to the patient’s complaint including tests ordered and actions taken. This part provided the opportunity to evaluate how participants interpreted and understood the physicians’ actions and the unfolding events of the story (the vignette used for the present study can be seen in Appendix IV.3).

Manipulations

The goal of this study was to demonstrate that subtle changes in the description of the patient’s personality/character influences physicians’ reasoning and decision making.

As portrayed in the described vignette, a key to early identification of the patient's pathophysiology was the physician's grasp of the patient's stoic personality and tendency to 'minimize' his problems. The described physician used knowledge about the patient's stoic character to interpret subtle physical symptoms such as 'chest tightness' as relatively more important, which led to the identification of the patient's AMI. Thus, the manipulation of this vignette focused on the description of the patient's personality. The original vignette introduced the patient as 'a very stoic person.' In addition, preliminary testing with medical students revealed that another patient descriptor – the patient was also classified as 'a blue collar worker' – impacted the perception of a minimizing patient. To test the hypothesis that subtle changes in the description of a patient's personality impacts physicians' decision making, three personality descriptions were developed for this study to create three different versions of the vignette. The first version was created based on the original description of the patient as '*a blue collar worker and a very stoic person.*' This version was hypothesized to increase the perceived seriousness of the patient's 'mild' chest pain and therefore result in more targeted evaluation and treatment decisions. The second manipulation was designed to reflect a conceptually 'opposite' description of the patient as '*a white collar worker and a very apprehensive person.*' Finally, the third version was designed to reflect a *baseline condition* without any patient descriptor (manipulations are included in the vignette provided in Appendix IV.3). Both the second and third versions of the vignette were hypothesized to result in the literal perception of 'mild' chest pain as not reflecting a serious medical condition.

Measures

Manipulation check

To test whether vignettes with one of the three patient descriptions were perceived differently, participants were asked at the end of the experiment to characterize the patient by responding to the following question: ‘If you had one word to characterize the patient in this story, what word would that be?’

Dependent measures

To assess differences in participants’ decision making, reasoning processes, use of ecological information (clues), as well as the goals and values underlying their decision making, several classes of dependent measures were used for this study (for the questionnaire see Appendix IV.3). Except for one question (i.e., ‘What would you say is this physician’s ‘secret’?’), all questions were asked after participants had read the first part of the story. In general, to be able to obtain participants’ genuine responses to the vignette, participants were first asked to respond to more general and broad questions (e.g., hunches). More specific questions, which may require more deliberation, were asked at the end of the survey.

Decision measures. Several measures were designed to assess the *decisions* participants made. Particularly, with respect to disposition decisions, participants were asked to rate the likelihood that the patient depicted in the vignette will have to stay in the hospital for a 23-hour observation period (ranging from 0 to 100%) and for a full admission (ranging from 0 to 100%). In addition, participants were asked to gauge the amount of time (in minutes) the described case would likely take. After having responded to these solution-oriented questions, participants were asked to list *major medical*

concerns they associated with the presentation of the described patient and to *order* appropriate *medical tests* and *medications*.

Measure of clues used. To assess the kinds of information categories participants used, they were asked to list the clues they considered relevant for the evaluation of the patient described in the vignette and rate the importance they associated with these clues on a 7-point scale ranging from ‘Somewhat important’ to ‘Very important.’ In addition, participants were asked whether they would have done anything differently during a first encounter with the described patient and what kind of additional information they would have asked/looked for had they evaluated the patient themselves.

Measures of values. To assess participants’ *values*, they were asked to rate the importance of certain aspects of the doctor-patient interaction with respect to cases such as the one described in the vignette they had been given. To assess participants’ importance ratings, a 10-point scale was used ranging from ‘Very unimportant’ to ‘Very important.’

Measures of reasoning processes. Next, several measures were devised to assess participants’ *reasoning processes*. Particularly, immediately after having read the vignette, participants were asked to describe the first thoughts coming to their mind with respect to the patient and his complaint. In addition, participants were asked to provide short but open-ended rationales for the major concerns they associated with the described patient as well as for their importance ratings of certain aspects of the doctor-patient interaction and the clues they considered relevant for the evaluation of the patient. Finally, after having read the second part of the vignette, participants were asked to provide an explanation of how the physician depicted in the story might have known that

the patient was having an AMI ('What would you say is this physician's 'secret'?'). This final question aimed to assess whether the applied manipulations impacted participants' understanding and interpretation of the story as a whole.

Confidence/satisfaction measures. Finally, three questions were asked to assess participants' confidence and satisfaction with respect to their performance. Specifically, immediately after having read the vignette, participants were asked to rate their confidence that they had a good grasp of the patient's complaint on a 10-point rating scale ranging from 'Very unsure' to 'Very confident.' At the end of the survey, participants were asked to rate their confidence that their overall evaluation and treatment plan would be successful (using the same confidence rating scale as above) and their satisfaction with the evaluation and treatment plan they developed. Satisfaction was assessed using a 7-point version of Kunin's (1955) faces scale ranging from 'Very dissatisfied' to 'Very satisfied.' These scores could not be meaningfully combined into composite scores and were therefore analyzed as separate measures.

Covariate scale measures

Mindfulness/Mindlessness. For the present study, the Mindfulness-Mindlessness Scale (MMS) developed by Bodner and Langer (2001) was used to measure physicians' individual differences in the propensity to be mindful, that is trait mindfulness (see Appendix IV.3.1). The MMS consists of 21 items, which are conceptually divided into 4 subscales⁸³. Specifically, 4 items pertain to the subscale labeled 'Flexibility.' An example item is "I am always open to new ways of doing things." The second subscale 'Novelty Seeking' consists of 6 items such as "I like to investigate things." The third subscale 'Novelty Producing' is captured by 6 items such as "I generate few novel ideas." Finally,

the fourth subscale ‘Engagement’ is reflected in 5 items, for example “I seldom notice what other people are up to.” Participants were asked to rate their agreement with all MMS items on a 7-point scale ranging from ‘Strongly disagree’ (1) to ‘Strongly agree’ (7). The MMS score was computed by summing up ratings across all items after reverse-scoring negatively keyed items. Higher scores on the MMS indicate higher levels of trait mindfulness. Bodner and Langer (2001) did not report coefficient alphas for the MMS. In this study, the internal reliability coefficient for the summed MMS score was $\alpha = .69$.

Patient-centered behavior. A situation-specific measure of mindfulness in patient-doctor encounters was created for this study by adapting the 6-item short version of the Health Care Climate Questionnaire (HCCQ) developed based on Self-Determination theory (cf. HCCQ, 2009). The scale is usually administered to patients to evaluate their perception of the degree to which their physicians are autonomy supportive (i.e., encourage active engagement in the care process and make patients feel comfortable sharing information). For this study, the items were reformulated to reflect physicians’ patient-centered behaviors as well as their listening skills⁸⁴ (see Appendix IV.3.2). Example items include “I feel that I provide my patients with choices and options” and “I listen to my patients and how they would like to have things done.” Participants were asked to rate their agreement with the revised 6-item HCCQ on a 7-point scale ranging from ‘Strongly disagree’ (1) to ‘Strongly agree’ (7). Scale scores were calculated by averaging individual rating scores after reverse-scoring negatively keyed items. Higher average scores indicate higher levels of a physicians’ patient-centered behavior. In the literature, coefficient alphas for the short 6-item HCCQ ranged from $\alpha = .72$ (e.g.,

Williams, Cox, Kouides, & Deci, 1999) to $\alpha = .85$ (e.g., Kasser & Ryan, 1999). The internal reliability coefficient in this study for the revised HCCQ was $\alpha = .66$.

Demographics

A demographics measure was administered to assess variables such as sex, age, educational status (i.e., first, second, or third year of residency), graduation dates, and experiences outside of the field of emergency medicine (see Appendix IV.3.3). These variables were used to describe the nature of the sample, control for potential confounding variables and to be able to assess potential alternative explanations for the observed effects.

Procedure

This study was administered after participants performed an in-training exam, which is designed to assess the clinical performance of emergency physicians in training. Once participants completed the in-service exam, they received materials for the present study. As part of this study, each participant received one package containing in the following order a consent form; the first part of the vignette; a questionnaire assessing participants' decisions, reasoning processes, information use, and values; the second part of the vignette; and a final questionnaire containing the MMS and HCCQ scales as well as the demographics measure (for the complete questionnaire see Appendix IV.3; IV.3.1-3). As stated on the consent form, if participants chose to participate they were given the option to make the performance score on their in-service exam available for the purposes of this study. After participants consented, the experiment started on the second page of the package with a description of the study procedure. Specifically, instructions stated that the study consisted of one medical case description with two parts. Participants were

asked to read part one of the vignette before working on the questionnaire. They were instructed to continue with reading the second part of the vignette only after they had finished answering the questions pertaining to part one. After having read part two of the vignette, participants were asked to respond to one additional question concerning their interpretation and explanation for why the described physician identified the patient's AMI. Finally, participants were asked to rate the MMS and HCCQ items, characterize the patient in the story with one word (the manipulation check), and respond to the demographics measure.

VI. RESULTS OF THE SURVEY STUDY

The first goal of this survey study was to disentangle the impact of specific ecological structures on physicians' reasoning processes, the information clues they use when engaging in these processes as well as their actual decisions. Given a plethora of potential influences on medical decision making, this study followed up on the observational finding that ED physicians' understanding of their patients' needs and circumstances impacts the physicians' ability to identify the patients' medical problems as well as ways to adequately address these problems. Specifically, this study investigated how the perception of a particular patient personality impacts ED physicians' reasoning and decision making.

Manipulation Check

Before examining whether or not participants' reasoning and decision patterns changed as a function of perceived patient personality, it was important to ascertain that the patient was indeed perceived differentially in the three conditions. To obtain a measure of participants' perception of the described patient, they were asked at the end of the experiment to characterize the patient in the vignette with one concise word. In addition to this one-word descriptor, the qualitative responses were searched for additional descriptions of the patient that further qualified participants' perception of the patient portrayed in the vignette. As can be seen in Table 1 (descriptors referring to the patient's ability to effectively communicate information are italicized and bolded), 10 out of 13 participants receiving a vignette with the patient portrayed as a stoic, blue collar worker characterized the patient as either stoic (6), a patient who is 'minimizing' (1),

denying (1), ‘brushing off’ (1), or not well articulating his complaint (1). Similarly, out of the 13 participants who received a vignette with the patient portrayed as an apprehensive, white collar worker, 10 participants characterized the patient either as stoic (3) or a non-complainer (2) who is minimizing his complaint (3), not forthcoming (1), or providing a benign explanation of his pain and complaints (1). Finally, 9 out of 13 participants receiving the vignette without an explicit patient descriptor (baseline) perceived the patient either as stoic (5), a downplayer (1), someone who is stubborn and cannot give a good history (1) or a patient who is minimizing his symptoms (2). That is, in each condition an almost identical proportion of participants – that is, 10 out of 13 in both the stoic and apprehensive and 9 out of 10 in the baseline condition – perceived and characterized the patients in similar ways with respect to the patient’s reduced ability to effectively communicate symptoms, feelings, and medical history. This suggests that the manipulation was *not* effective and conclusive statements with respect to the hypothesized relationships between perceived patient personality and participants’ reasoning and decision making will not be possible.

However, of the 39 participants in Table 1, 10 or 25.6% characterized the patient either with generic labels (e.g., typical, male, normal) or with terms such as sick, restless, fortunate, and scared. Unlike the descriptors mentioned above, these descriptions did not directly and functionally relate the characterization of the patient to his ability to convey the amount and quality of medical information necessary for effective care delivery. In general, characteristics of the patient did not play a functional role in the overall responses of these 10 participants (i.e., they characterized the patient only when specifically asked to provide a one-word descriptor at the end of the experiment). Thus,

to examine whether or not participants' reasoning and decision patterns changed as a function of perceived patient characteristics, group comparisons were performed based on whether or not participants considered the functional implications of the patient's stoic character (communicative abilities) when reasoning about the patient, his medical complaint, and appropriate courses of action.

Table 1

Participants' Perceptions of Patient Personality Split by Type of Vignette Received

Vignette 1 Stoic/blue collar worker		Vignette 2 Apprehensive/white collar worker		Vignette 3 Baseline (No descriptor)	
Descriptor	All responses	Descriptor	All responses	Descriptor	All responses
<i>Stoic</i>		<i>Stoic</i>		<i>Stoic</i>	
<i>Stoic</i>		<i>Stoic</i>		<i>Stoic</i>	
<i>Stoic</i>		<i>Stoic</i>		<i>Stoic</i>	
<i>Stoic</i>		<i>Non-complainer</i>		<i>Stoic</i>	
<i>Stoic</i>		<i>Non-complainer</i>		<i>Downplayer</i>	
<i>Stoic</i>		Common	<i>Minimizing</i>	Challenging	<i>Stoic</i>
<i>Minimizer</i>		Wife	<i>Minimizing</i>	Typical	<i>Minimizing</i>
<i>Denial</i>		Fortunate	<i>Minimizing</i>	Lucky male	<i>Minimizing</i>
Passive	<i>Brushing off condition</i>	Reserved	<i>Not forthcoming</i>	Male, older, Typical	<i>Stubborn, cannot give good history</i>
Atypical	<i>not articulating feelings/symptoms well</i>	Typical	<i>No clear/less benign explanation</i>		
Typical		Typical		Typical	
Male		Fortunate		Normal	
Sick		Restless		Male	
				Scared	

Qualitative Differences in Participants' Responses

Apart from participants' perception of the patient's stoic character, which was of particular conceptual interest with respect to the selected vignette and the first goal of this study, other qualitative differences were investigated and identified in participants' open-ended responses with the goal to cross-validate and extend the observational findings (i.e., to address the second and third goal of this study). Specifically, qualitative analyses were performed on open-ended responses participants provided with respect to their first thoughts after reading the vignette, (medical) concerns stated, clues they were using based on the information provided, additional information they would have asked/looked for, things they would have done differently during an encounter with the described patient, as well as the rationales they provided for their responses.

Participants' responses did not clearly fall within the response categories pre-defined on the questionnaire. Thus, similar to the observational study, participants' responses were coded with respect to the clues participants used as well as how they used these clues to reason about potential medical problems (what mattered for the patient) and appropriate courses of action (what should have been done for/with the patient). Based on their written responses, 39 participants used a total number of 29 different clues and stated 26 different medical concerns. Given the plethora of different clues and concerns statistical analyses of the raw data was impractical. Instead, an iterative coding process was used to develop compound categories and coding schemes that would describe the obtained data at a more aggregate level, allow meaningful statistical analyses, as well as the comparison of the survey data with the observational findings⁸⁵.

Each set of responses (i.e., filled-out survey) was eventually categorized (dichotomized) with respect to the presence or absence of participants' reasoning about four high-level clue categories as well as two factors related to participants' behavioral intentions and attitudes. That is, if a participant's set of responses contained at least one statement referring to the corresponding category the set was coded as "1." If the set of responses did not contain any clue of a category, it was coded as "0." Based on this categorization, sample codings used to assess interrater reliability averaged between $\alpha = .7$ and $\alpha = .85$. The categorization scheme presented in Table 2, which includes participants' perception of the patient's stoic character, forms the basis for the statistical analysis and description of the sample data. This scheme will be discussed in more detail before the analytic results will be presented.

Participants' reasoning about clue categories

Participants' reasoning about medical clues/symptoms. As can be seen from Table 2 the four major clue categories included, not surprisingly, medical clues such as chest pain, nausea and vomiting, and other symptoms described in the vignette. As was to be expected, all of the 39 resident physicians who participated in this study used at least one medical clue/symptom when reasoning about the patient's potential medical problems (i.e., 'worst cases') as well as appropriate evaluation procedures. Table 3 summarizes the different kinds of medical clues identified in participants' responses. Although 'minimized' by the patient, the most salient clue to participants was the patient's subtle chest pain with 37 out 39 participants (95%) mentioning this clue in their responses. Similarly, the patient's main complaint coming into the ED – nausea and vomiting – was used by a majority of participants (32 out of 39 or 82%). In reasoning

about the patient's complaint, exactly 1/3 of the participants referred to the course of the patient's symptoms (i.e., it started with nausea and vomiting at night, now the patient has slight chest and/or shoulder pain) and about 31% (12 out of 39 participants) mentioned the patient's shoulder pain (the patient in the vignette had 'rubbed his shoulder').

Table 2

Dichotomous Categories (Presence/Absence) of Clues and Intentions/Attitudes Identified in Participants' Responses

Proportion of participants with at least one statement of the corresponding clue category	%-age	Clue category reasoned about
<i>39 out of 39</i>	<i>100%</i>	<i>Medical clues (symptoms)</i>
<i>33 out of 39</i>	<i>85%</i>	<i>Non-medical clues</i>
29 out of 39	74%	Stoic character
16 out of 39	41%	Contextual clues
<i>31 out of 39</i>	<i>79%</i>	<i>Epidemiological clues</i>
26 out of 39	67%	Demographic clues
12 out of 39	31%	Patient's appearance
<i>4 out of 39</i>	<i>10%</i>	<i>Organizational clues/constraints</i>
Category of attitudes/intentions		
12 out of 39	31%	Intention to engage in rapport-inducing behaviors
11 out of 39	28%	Intention to maintain a cautious attitude

Note: Main clue categories are italicized.

Further, 8 out of 39 participants (31%) mentioned the patient's difficulty swallowing and 5 out of 39 participants (21%) considered 'abdominal comfort' when reasoning about the patient's medical problem. Only one participant used the absence of clues, which would point to a gastrointestinal cause of the patient's complaints (e.g., no

diarrhea, ability to take fluids), to reason and provide a rationale for ruling out cardiac problems.

Table 3

Proportion of Participants by Kinds of Medical Clues Used

Proportion of participants	% -age	Medical symptoms
39 out of 39	100 %	At least one of the below
37 out of 39	95 %	Chest pain
32 out of 39	82 %	Nausea & vomiting
13 out of 39	33 %	Course of symptoms
12 out of 39	31 %	Shoulder pain
8 out of 39	21 %	Difficulty swallowing/clearing throat
5 out of 39	13 %	Abdominal discomfort/pain
<i>Absence of medical symptoms</i>		
1 out of 39	0.3 %	No diarrhea, ability to take fluids, no fever/chills, no travel

Based on the symptoms described in the vignette, 20 participants explicitly stated their intentions to rule out cardiac etiologies (i.e., acute myocardial infarction (AMI), acute coronary syndrome (ACS) etc) and an additional 17 participants stated cardiac etiologies as their major concern (i.e., ‘worst case’) for the described patient. In other words, the majority of participants used medical clues to identify medical ‘worst cases’ (i.e., a cardiac event) to be ruled out during the evaluation of the patient. One of the two participants who did not mention cardiac etiologies, had erased “MI” (Myocardial infarction) from the list of concerns. The other participant recognized ‘a’ potential threat but did not specify the concern when asked to list major concerns for the described patient. Both participants were first-year residents.

Apart from clues provided in the vignette, participants were also asked to list further information (clues) they would have asked/looked for had they cared for the described patient. All participants requested medical information such as the patient's previous medical history (e.g., prior similar medical event), vital signs, a better physical exam and history of ongoing illness (e.g., alleviating/aggravating factors, information about last bowel movements, sick contacts etc). As the main reason for obtaining this additional information, participants stated an improved ability to 'risk stratify' and assess the probability of other (mainly more benign) medical problems apart from cardiac disease that may underlie the patient's complaints. Five out of 39 participants (13%) also requested information either from the patient's wife, about the patient's family physician, or the patient's family history of certain diseases for similar reasons. Although an important conceptual finding, the ubiquitous use of medical clues resulted in low variability with respect to the particular kinds of medical clues participants considered in their responses. Thus, this clue category was excluded from further statistical analyses.

Participants' reasoning about contextual clues. According to Table 2, the second most commonly used clue category – 33 out of 39 participants (85%) used at least one non-medical clue – is comprised of two overlapping subclasses. Specifically, 29 out of 39 participants (74%) used the patient's stoic character (see Table 1) as a particular contextual clue whereas 16 out of 39 participants (41%) used at least one 'other' contextual clue, which was unrelated to the patient's stoic character. Table 4 summarizes the categories of information coded as 'other' contextual clues, which participants used to gauge the severity of the patient's medical problem. Overall, 16 out of 39 participants (41%) used at least one clue of this category.

Table 4

Proportion of Participants by Kinds of Contextual Clues Used

Proportion of participants using clue category	%-age	Contextual clue category
16 out of 39	41%	At least one of the below
<i>Related to the patient's wife</i>		
9 out of 39	23 %	Patient was brought in by a <i>concerned</i> wife
<i>Related to the 'clinical gestalt'</i>		
2 out of 39	5 %	Men don't come in for mere suspicion
2 out of 39	5 %	Time of day: Patient came in middle of night/ AM is common MI time
<i>Related to the Physician</i>		
2 out of 39	5 %	Participant had recent experience with a similar Case

The most common clue associated with this clue category – 9 out of 39 participants (23%) used this clue – was based on the fact that the patient was brought in by a concerned wife (e.g., ‘The patient has chest pain (bad) with nonspecific vomiting (bad), *wife forced him to come to ER* (bad)’). A second type of contextual clue was related to the physicians’ overall impression – clinical gestalt – with respect to the circumstances under which the patient was brought in. Specifically, 2 out of 39 participants (5%) stated that a patient who comes to the ED in the middle of the night likely suffers from a ‘serious’ medical problem (e.g., ‘The patient "doesn't look quite right" – was brought in by wife [] (cautious) he *came in the middle of the night* for unspecific complaint’). Similarly, 2 participants stated that men, in general, do not come to the ED for mere suspicion. Finally, 2 participants were stating current experiences with a case similar to the one presented in the vignette.

Participants' reasoning about epidemiological clues. Table 2 also lists epidemiological information as another category of widely used clues. Specifically, at least one epidemiological clue was used by 31 out of 39 participants (79%). This super-category was again split into two overlapping subclasses, which were used for the purposes of further statistical analyses. Specifically, 26 out of 39 participants (67%) used at least one demographic clue such as the patient's age, sex, and previous medical history when reasoning about likely medical problems underlying the patient's complaints. Participants used this type of epidemiological information to reason about likely medical problems (i.e., 'worst cases') underlying the patient's complaints. Clues from the second subclass, information about the patient's physical appearance (i.e., 'Edsel didn't look so good'), were used by 12 out of 39 participants (31%). Participants used this type of epidemiological information to reason about the severity of the patient's medical problem.

Table 5 summarizes the categories of information coded as epidemiological clues as well as the proportion of participants (with respect to the total sample) using this clue category. Specifically, the most common demographic clue was age information with 16 out of 39 participants (41%) using the patient's age to reinforce concerns about possible cardiac etiologies (e.g., 'With chest pain - MI - most likely [diagnosis] with high morbidity/mortality. Vomiting with his *AGE* and [abdominal] pain in a stubborn old dude = bad to me'). The next most common demographic clue was the patient's lack of a previous cardiac history with 15 out of 29 participants (38%) using this type of clue to provide a rationale for why cardiac etiologies should be ruled out (e.g., 'I have to rule out MI: Patient has chest pain ongoing without relief; *no history of previous complaints*').

Table 5

Proportion of Participants by Kinds of Epidemiological Clues Used

<i>Proportion of participants using clue category</i>	<i>%-age</i>	<i>Epidemiological clue category</i>
31 out of 39	79%	At least one of the below
26 out of 39	67%	<i>Demographic clues</i>
16 out of 39	41 %	Age (~50 years old)
15 out of 39	38 %	No previous medical history [related to the complaints]
11 out of 39	28 %	Sex (male)
1 out of 39	3 %	Ethnicity (white)
12 out of 39	31 %	<i>Appearance of the patient</i>
12 out of 39	31 %	Patient “doesn’t look good”/ seems “sick”/ is “just not feeling right”

The last demographic clue identified in participants’ responses was the patient’s sex. This clue was used by 11 out of 39 participants (28%) as another reason for why the patient might be suffering from a cardiac event (e.g., ‘I have a concern for MI: The patient is a 50 something *male* with vomiting and chest pain’). Only one participant associated the patient with a particular ethnicity (even though the vignette did not explicitly mention the patient’s ethnicity). Finally, with respect to the patient’s physical appearance, 12 out of 39 participants (31%) referred to statements made in the vignette about the patient ‘not looking good’ or ‘not feeling right’ when evaluating the severity of the patient’s possible heart condition (e.g., “I’m worried he is having an MI: He is nauseated, vomiting, with chest tightness, left shoulder pain and abrupt symptoms, plus he's 48 and *looks sick*’).

Participants' reasoning about organizational clues/constraints. Finally, as shown in Table 2, 4 out of 39 participants (10%) reasoned about organizational clues/constraints. As shown in Table 6, these clues referred to constraints that pertain to a distributed health care system (e.g., 'Does he have a PCP [primary care physician] for adequate follow-up?') or constraints that pertain to the ED/hospital organization (e.g., 'A family history of cardiac history helps to make the case if the patient is to be admitted').

Table 6

Participants' Statements Coded as Pertaining to Organizational Constraints/Clues

<i>Constraint category</i>	<i>Incidences</i>
Distributed health care system	Does he have a PCP [primary care physician] for adequate follow up? (2 incidences)
Distributed health care system	Likely poor follow-up in the past [provided as a rationale for cardiac concerns/work-up]
ED/hospital system	Family history helps make case if admission is needed
ED/hospital system	Admission depends on what is subsequently ordered and who follows [patient] up in the ED. What will happen to this patient depends on what labs/studies are ordered and whether Dr. Black [the physician in the vignette] versus new Attending manages his care and how the checkout goes.

Given the low number of participants reasoning with these organizational clues/constraints, this category will not be included in further statistical analyses. However, it is reassuring with respect to the observational findings that participants reasoned about organizational constraints not only in a naturalistic setting but even when given a paper-and-pencil task and despite the fact that the experimental task was mainly focused on the initial (medical) evaluation of the patient.

Participants' intentions/attitudes

With respect to intentions/attitudes, two different categories could be identified in participants' responses: participants intentions to engage in rapport-inducing behavior

and a tendency to maintain a ‘cautious’ attitude with respect to the information provided by the described patient. These categories reflect strategies to cope with the social dynamics inherent in emergency care delivery and correspond conceptually to those identified during observations. For example, observed ED physicians helped patients share information and feel comfortable. Simultaneously, they tried to maintain a cautious/mindful attitude about possible changes in the meaning and significance of information/symptoms and their implications for the care delivery process. The identified attitudes/intentions are also reflected in the covariate scale measures administered as part of this study (i.e., Langer’s mindfulness/mindlessness scale and the revised Health Care Climate Questionnaire (HCCQ) scale intended to measure participants caring, patient-centered attitude).

Participants’ intentions to maintain a ‘cautious’ attitude. As shown in summary Table 2, 11 out of 39 participants (28.2%) explicitly stated a concern and intentions to be careful/cautious when evaluating and/or ordering tests for the patient described in the vignette (e.g., ‘The patient is minimizing [his] complaint; must be careful there is no real pathology here’). Table 7 lists those statements that were coded as reflecting a ‘cautious’ attitude. Although the proportion of participants who made statements about maintaining a ‘cautious’ attitude did not differ depending on whether or not they incorporated the patient’s stoic character in their clinical reasoning (Yates’ $\chi^2(1) = .02, p = .884$; see Table 9), the excerpts show that participants who did (not) reason about the patient’s stoic behavior differed with respect to the *process* or *rationale* underlying their ‘cautious’ attitude.

Table 7

Summary of Responses Coded as Reflecting Participants' Mindful/Cautious Attitude

<i>Rationale</i>	<i>Coded responses</i>
<i>Statements by participants who reasoned about the patient's stoic character</i>	
Stoic character	Patient minimizing - gives a potentially false sense of security
Stoic character	More serious than he is letting on, I am concerned at this point. He is minimizing his symptoms.
Stoic character	Good history should be done since the patient is very <i>stoic</i>
Stoic character	Minimizer/ subtle presentation /easy to miss/ have to count on [] sense
Stoic character	Patient is minimizing complaint. Must be careful there is no real pathology here.
Stoic character	Patient is stoic = extremely important to ... get a good history.
Physician functioning	Do not rely on other people to do things/relay symptoms to you.
Worst case	He has the potential of becoming very unstable.
<i>Statements by participants who did not reason about the patient's stoic character</i>	
Physician functioning	Must be astute and careful to obtain adequate history and physical exam, especially at early AM/fatigued time.
Physician functioning/ Worst case	Listen well to not misinterpret gastroenteritis and miss subtle chest pain.
Worst case	ACS [Acute Coronary Syndrome] = subtle disease process that is often overlooked in patients with atypical symptoms.
Worst case	Hypervigilance, assume the worst until you prove it's not.

Specifically, participants who incorporated the patient's 'non-complaining' character in their reasoning were 'cautious' mainly because of the patient's stoic demeanor. On the other hand, participants who did not explicitly consider the patient's stoic character based their statements on 'worst case' thinking with respect to the given medical problem or a generic 'cautious' attitude as part of ED physicians' routine approach to care delivery. This suggests that maintaining a 'cautious' attitude forms part of 'worst case' thinking (i.e., is an accepted method in the ED), which may, in some

cases, be triggered and situationally grounded by physicians' awareness and interpretation of *contextual clues* such as patients' stoic behavior.

Participants' intentions to engage in rapport-inducing behavior. Another category of responses could be identified with respect to participants' intentions to create or induce rapport with the type of patient described in the vignette. As shown in summary Table 2, 12 out of 39 participants (30.8%) explicitly stated their intentions to make the patient feel more comfortable to obtain better information (i.e., engage in rapport-inducing behaviors) had they been caring for the patient portrayed in the vignette. For example, participants stated that they would have 'been much more pleasant to make the patient feel comfortable' and tried to 'let the patient talk more.'

Table 8 lists those statements that were coded as reflecting a patient-centered attitude. In this table, each incidence was categorized with respect to the categories of rapport-inducing behaviors identified based on the analyses of the observational data (e.g., helping the patient share information, participate in the care process, or making the patient feel comfortable). As for statements reflecting a 'cautious' attitude, the proportion of participants who stated that they would engage in rapport-inducing behaviors did not differ depending on whether or not they incorporated the patient's stoic character in their reasoning (Yates' $\chi^2 = 0.01$, $p = .951$; see Table 9). Similarly, as can be seen in Table 8, whether or not participants used patient characteristics in their reasoning was independent of a particular category of rapport-inducing behavior. That is, incidences reflecting physicians' intentions to 'help the patient share information,' 'make the patient feel more comfortable,' and to 'incorporate the patient in the care process' could be found equally

in both participants who reasoned about the patient's stoic character as well as those who did not.

Table 8

Summary of Responses Coded as Reflecting Participants' Intentions to Induce Rapport

<i>Category of rapport-behavior</i>	<i>Incidences</i>
<i>Statements by participants who considered the patient's stoic character</i>	
Help patient share information	Let the patient talk more
Help patient share information	Patients often belittle symptoms and medical problems. Ask more direct questions. (2 incidences)
Help patient share information	Allow patient to describe symptoms. Yes/No questioning with stoic patients limits useful info as in this case.
Help patient share information	More open ended questions
Help patient share information/ feel comfortable	Good rapport makes for better interviews and clues about real problem.
Help patient share information/ feel comfortable	Be more pleasant and express my concern to elicit more info
Help patient share information/ feel comfortable/ participate in care process	More interaction with patient, less "cavalier" attitude. Elicit the story/symptoms and put it into perspective with clinical exam. Spent more time so patient feels more comfortable expanding on symptoms/history.
<i>Statements by participants who did NOT consider the patient's stoic character</i>	
Help patient share information	Let the patient talk more (2 incidences)
Help patient share information	More open ended questions
Help patient feel comfortable/ participate in care process	Would like to think I might have been more compassionate, thorough & personable with the patient. Realistically, minimal added time would have been needed. If rude to the patient, he might leave AMA [Against Medical Advice]. ... Better explanation to the patient about the doc's thoughts.

Statistical Description of the Identified Response Categories

Table 9⁸⁶ summarizes χ^2 -tests of independence, corresponding p -values, and ϕ -(phi)-correlation coefficients to statistically describe the properties and relationships between the dichotomous (presence/absence) response categories described above. Response categories reflecting participants' use of medical (100%) or organizational constraints/clues (10%) are omitted in Table 9 because they lacked variability and were

excluded from statistical analyses. For similar reasons, the super-categories representing non-medical and epidemiological clues are not included in the table. Instead, the corresponding subclasses were used for statistical analyses. The frequency counts for each of the dichotomous response categories as well as the 2x2 contingency tables for each category combination can be found in Appendix V.1.

The diagonal of Table 9 displays χ^2 -tests of independence and corresponding p -values comparing the proportions of participants using versus not using a single clue category. Given the null hypothesis of the χ^2 -test (i.e., the proportions are of equal size), it can be seen that significantly more participants used the patient's stoic character (SC) ($\chi^2(1) = 9.25, p = .002$) and demographic clues (D) ($\chi^2(1) = 4.33, p = .037$) than not. Conversely, only a minority of participants used information about the patient's physical appearance (A) ($\chi^2(1) = 5.77, p = .016$), explicitly stated their intentions to engage in rapport-inducing behaviors (R) ($\chi^2(1) = 7.41, p = .006$) or provided responses reflecting their intentions to maintain a 'cautious' attitude (S) ($\chi^2(1) = 5.77, p = .016$). Whether or not participants used contextual clues (C) was equally likely ($\chi^2(1) = 1.26, p = .262$).

Before analyzing the identified categories with respect to the obtained measures, it was important to test whether the coded responses were describing qualitatively unique (i.e., statistically independent) features of participants' responses or simply different subsets of a single or a smaller number of features. Given the null hypothesis of the χ^2 -test with respect to 2x2 contingency tables (i.e., the compared categories are statistically independent), results indicated that all of the identified categories were statistically independent (i.e., all χ^2 -test were non-significant). The largest binary correlation among the remaining categories was $\phi = -.26$ between the categories reflecting participants' use

of contextual clues and demographic clues as well as between the categories reflecting participants' reasoning about the patient's stoic character and the patient's physical appearance. Both correlations were non-significant and of small to moderate size (Cohen, 1988). In other words, all six dichotomous codes (i.e., SC, C, D, A, S, and R) were statistically unrelated and therefore warranted treatment as distinct features of participants' responses.

Table 9

Summary of χ^2 -Tests of Independence

		<i>Clues</i>			<i>Attitudes/Intentions</i>		
<i>Clues</i>		SC	C	D	A	S	R
Stoic character (S)	$\chi^2(1)$	9.26					
	p	.002**					
	ϕ						
Context (C)	$\chi^2(1)$	0.09 ¹	1.26				
	p	.767	.262				
	ϕ	.01					
Demographics (D)	$\chi^2(1)$	0.42 ¹	1.60	4.33			
	p	.517	.169	.037*			
	ϕ	-.17	.26				
Appearance (A)	$\chi^2(1)$	1.57 ¹	0.09 ¹	1.22 ¹	5.77		
	p	.210	.765	.270	.016*		
	ϕ	.26	-.01	.24			
<i>Attitudes/Intentions</i>							
Suspicion (S)	$\chi^2(1)$	0.07 ¹	0.51 ¹	0.02 ¹	0.01 ¹	7.41	
	p	.794	.475	.899	.929	.006**	
	ϕ	-.01	-.17	.04	.05		
Rapport (R)	$\chi^2(1)$	0.11 ¹	0.09 ¹	1.22 ¹	0.02 ¹	0.74 ¹	5.77
	p	.737	.765	.270	.884	.390	.016*
	ϕ	-.01	-.01	-.24	-.04	-.20	

Note: p = probability value. ϕ = phi-correlation coefficient for binary variables. For each contingency table, χ^2 -tests of independence, p -values, and ϕ -correlation coefficients are provided below the diagonal (lower left part of table).

¹ Yates' χ^2 correction was used for all comparisons where expected cell frequencies were smaller than 5.

* $p < .05$, ** $p < .01$

In the analyses described below, the identified response categories were used as independent variables to investigate and describe their relationships with demographics, rating scales, performance as well as the dependent measures obtained via the

questionnaires. The classes of dependent measures used for these analyses will be defined and described next.

Description of Dependent Measures

Apart from qualitative differences, the data obtained via the questionnaires provided several classes of (continuous and categorical) dependent measures⁸⁷. First, participants provided *demographic information*. As can be seen from Table 10, significantly fewer participants (12 out of 39 or 30.8%) were female than male ($\chi^2(2) = 5.77, p = .016$). Participants' mean age was 31.5 years with a standard deviation of approximately 4 years. The sample was statistically balanced with respect to participants' tenure as ED resident physicians ($\chi^2(2) = 0.15, p = .923$). Specifically, out of 39 participants 14 or 35.9% were first-year, 12 or 30.8% were second-year, and 13 or 33.3% third-year resident physicians. As can be seen from Table 10, there were no significant interrelationships between sex, tenure as ED resident, and age in the overall sample.

In addition to demographic information, the *order in which participants returned their filled-out survey* was assessed as another individual difference variable. This measure is only a proxy of the time participants took to complete the survey study as participants started the experiment whenever they had completed a 200-item knowledge exam (i.e., at slightly different times). However, this measure ranks participants with respect to the completion time of the exam-survey session, which all participants started at the same time. There were no differences with respect to this rank ordered variable in terms of sex ($\chi^2(1) = 0.37, p = .543$) or tenure as ED resident ($\chi^2(2) = 1.36, p = .508$).

Table 10

Demographics and Their Interrelationships for the Overall Sample

	Sex		Tenure as Resident			Overall
	Male	Female	1-year	2-year	3-year	
Frequency	27	12	14	12	13	39
Percent	69.2%	30.8%	35.9%	30.8%	33.3%	100%
χ^2 -test of Independence	$\chi^2(1) = 5.77, p = .026^*$		$\chi^2(1) = 0.15, p = .926$			
Frequency by Males	-	-	10	7	10	27
Frequency by Females	-	-	4	5	3	12
χ^2 -test of Independence			$\chi^2(2)^1 = 0.36, p = .836$			
Mean Age in Years (SD)	32 (4.2)	30.7 (3.7)	30.8 (4)	31 (4.2)	32.9 (4)	31.5 (4)
Group differences	$F(1,37) = .85, p = .362$		$F(1,36) = 1.12, p = .337$			

Note: p = probability value. SD = standard deviation.

¹ Yates' χ^2 correction was used for all comparisons where expected cell frequencies were smaller than 5.

* $p < .05$

Second, participants responded to two rating scales intended to measure participants' level of mindfulness on the *mindfulness/mindlessness scale* (MMS) ($M = 110.7, SD = 10.2$) as well as their caring, patient-centered attitudes using a revised, short version of the *Health Care Climate Questionnaire* (HCCQ) ($M = 66.4, SD = 5.3$). Means, standard deviations, and correlations between all continuous study variables are summarized in Table 11. For five participants, missing values for items of the MMS were substituted with the mean score for those individuals on the remaining items of the scale. Moreover, one participant (number 26) scored more than 3 standard deviations above the mean for the MMS and was removed from further analyses involving this scale. One participant did not respond to the revised, short version of the HCCQ and was therefore excluded from further analyses involving the HCCQ.

Table 11

Means, Standard Deviations, and Intercorrelations between Continuous Study Variables

Variables	Mean	SD	MMS	HCCQ	AC	PS	P	SB	LS	ME	I	PS	FULL	OBS	PERF	CON	TST	MED
<i>Covariates</i>																		
Mindfulness/Mindlessness scale (MMS)	110.7	10.2																
Health Care Climate Questionnaire (HCCQ)	66.4	5.3	.45**															
<i>Importance ratings</i>																		
PT's ability to articulate complaints (AC)	8.62	1.2	.21	.12														
PT's physical symptoms (PS)	8.23	1.3	-.09	-.08	.49**													
PT's personality (P)	6.04	2.1	-.08	-.01	.29	.01												
PT's social background (SB)	5.55	2.4	.05	.10	.11	.01	.65**											
MD listening skills (LS)	8.95	1.1	-.12	-.13	.08	.08	.39*	.31										
MD expertise (ME)	8.27	1.4	-.11	.03	.36*	.30	.14	.09	.54**									
MD intuition (I)	8.77	1.1	.08	.01	.12	.06	.32*	.24	.58**	.52**								
MD people skills (PS)	8.38	1.4	.23	.08	.06	-.05	.25	.25	.59**	.38	.35*							
<i>Probability judgments (0-100 %)</i>																		
Full admission (FULL)	51.78	21.6	.01	-.09	-.01	-.13	-.29	-.13	.08	-.02	-.28	.24						
Admit for observation (OBS)	78.92	21.6	-.21	-.32	.10	-.13	.07	-.06	-.20	.07	.18	-.22	-.24					
<i>Clinical performance (0-100%)</i>																		
Score on exam (PERF)	73.71	8.6	.09	-.06	-.08	-.09	-.28	-.29	-.24	-.02	.09	-.06	.13	.25				
<i>Measures of decision outcomes</i>																		
# concerns (CON)	2.08	1.6	-.34	-.26	-.25	-.22	-.01	-.08	.02	-.29	.07	-.08	-.15	.17	-.07			
# test orders (TST)	9.72	3.0	.08	.01	-.08	-.10	-.07	.07	.25	.02	.03	.31	.32	-.19	.09	.07		
# medication orders (MED)	1.26	1.1	.12	-.14	-.16	-.16	.07	.12	-.12	-.32	-.08	-.07	.25	.05	.28	-.21	-.06	
# clues considered (Clue)	3.56	1.3	.26	.02	-.01	-.10	.04	.11	.01	.12	.19	.13	.06	-.09	.24	-.39*	.04	.40*

Note: PT = Patient. MD = Physician. SD = Standard deviation.

* $p < .05$, ** $p < .01$

As shown in Table 11, there was a significant correlation between the MMS and HCCQ. The MMS was unrelated to participants' sex ($F(1, 36) = .09, p = .766$), age ($F(1, 36) = .11, p = .739$), or tenure as ED resident physician ($F(2, 35) = .66, p = .524$). Similarly, the HCCQ did not differ with respect to participants' sex ($F(1, 36) = .82, p = .372$), age ($F(1, 36) = .06, p = .806$), or tenure ($F(2, 35) = 2.27, p = .118$). See Table 12 for a summary of initial group differences.

Table 12

Summary of Initial Group Differences

Continuous Measures	Initial Group Differences					
	Sex		Tenure as Resident			Age
	Male	Female	1-year	2-year	3-year	
<i>Covariates</i>						
MMS						
HCCQ						
<i>Importance ratings</i>						
Patient's personality			$F(2, 36) = 3.31, p = .048^*$			
Physical symptoms						$F(1,37) = 4.9, p = .032^*$
<i>Probability judgments</i>						
Full admission						
Admit for observation			$F(1,34) = 3.72, p = .035^*$			
<i>Clinical performance</i>						
Exam score			$F(1, 36) = 12.29, p = .001^{**}$			
<i>Decision outcomes</i>						
# of concerns			$F(1,37) = 4.8, p = .034^*$			
# of clues			$F(1,37) = 4.4, p = .044^*$			

Note: p = probability value.

* $p < .05$, ** $p < .01$

Third, participants provided *importance ratings* for 8 different aspects of the physician-patient interaction. Participants were asked to rate the importance of these factors with respect to cases similar to the one described in the vignette. Specifically, four aspects on the patient's side included the patient's ability to articulate complaints ($M = 8.62, SD =$

1.2), the patient's physical symptoms ($M = 8.23$, $SD = 1.3$), personality ($M = 6.04$, $SD = 2.1$), and social background ($M = 5.55$, $SD = 2.4$). On the physician's side, aspects included the physician's listening skills⁸⁸ ($M = 8.95$, $SD = 1.1$), medical expertise ($M = 8.27$, $SD = 1.4$), intuition ($M = 8.77$, $SD = 1.1$), and people skills⁸⁹ ($M = 8.38$, $SD = 1.4$). Participants' scores on these rating scales were independent of sex (see Table 3). Tenure as ED resident physician was related to participants importance rating of patient personality ($F(2, 36) = 3.31$, $p = .048$) in that first-year ED residents rated the patient's personality as more important ($M = 7.04$, $SD = 1.53$) than participants in their second ($M = 5.91$, $SD = 1.8$) and third year as ED residents ($M = 5.08$, $SD = 2.5$). Age was related to how important participants rated the patient's physical symptoms ($F(1, 37) = 4.96$, $p = .032$) in that for every year increase in age, participants were likely to rate physical symptoms (on a 10-point scale) 0.34 points more important ($b = .34$, $t(37) = 2.23$, $p = .032$).

Fourth, participants were asked to make two *probability judgments* (each ranging from 0% - 100%). The first judgment was related to the likelihood that the patient described in the vignette required *full admission* to treat a medically serious condition ($M = 51.78$, $SD = 21.6$). The second question required participants to judge how likely the patient's state of health required admission for *23 hours of observation*⁹⁰ (not full admission) as a *precautionary measure* to rule out *potential* 'worst cases' ($M = 78.92$, $SD = 21.6$). For each judgment task, two participants provided no responses. The judgment of how likely the patient required full admission was unrelated to participants' tenure as ED residents ($F(2, 33) = .78$, $p = .466$), age ($F(1, 34) = .001$, $p = .983$), and marginally related to participants' sex ($F(1, 34) = 3.68$, $p = .064$). The judgment of how likely the patient required admission for observation was unrelated to participants' sex ($F(1, 34) = 1.5$, $p =$

.228) and age ($F(1, 34) = .21, p = .650$) but significantly related to tenure as ED resident physician ($F(1, 34) = 3.72, p = .035$) in that first-year residents rated the likelihood for a 23-hour (observation) admission lower ($M = 46.5, SD = 18.6$) than both second ($M = 51.8, SD = 26.9$) and third year residents ($M = 57.4, SD = 19.4$).

Fifth, participants' *clinical performance* was measured as their (percentage) score on a comprehensive in-training examination ($M = 73.71, SD = 8.6$), which they took immediately prior to participating in the experiment. This exam is a test designed by the American Board of Emergency Medicine (ABEM) to "determine the resident's degree of preparedness for taking the ABEM qualifying examination" (ABEM, 2008), which is a prerequisite for accreditation as an emergency physician in the U.S. Two participants were excluded from the analyses because they did not release their scores for the purpose of this research. As was to be expected, performance on the exam was significantly related to participants' tenure as resident physicians in the ED ($F(1, 36) = 12.29, p = .001$). Post-hoc Bonferroni contrasts showed that third and second-year residents scored significantly higher ($M = 77.6, SD = 6.8$) than first year residents ($M = 66.9, SD = 7.2$). Participants' scores were unrelated to sex ($F(1, 37) = 1.44, p = .238$) and age after controlling for tenure as ED resident ($F(1,13) = .69, p = .754$).

Finally, *measures of evaluation and treatment decisions* included participants' test and medication orders as well as the medical concerns stated in their responses. Overall, participants mentioned 29 different medical concerns, ordered 5 types of medication, and 35 different medical tests/studies (see Appendix V.2-V.4). To evaluate single test and medication orders as well as differences in stated medical concerns, dichotomous variables were created (1 = ordered/stated; 0 = *not* ordered/ stated). To be able to statistically

evaluate these variables, each participant's total number of concerns ($M = 2.08$, $SD = 1.6$), test orders ($M = 9.72$, $SD = 3.0$), and medication orders ($M = 1.26$, $SD = 1.1$) were calculated. Given the overall high number of different clues used by the participants (26), a similar count (outcome variable) was created for the number of clues each participant stated in his or her responses ($M = 3.56$, $SD = 1.3$). As can be seen in Table 11, there was a significant negative correlation between the number of clues used and the number concerns stated as well as positive correlation between the number of clues and the number of medications ordered. All four variables were statistically unrelated to participants' tenure as ED residents as well as participants' age (see Table 3). However, participants' sex was related to the number of concerns stated ($F(1, 37) = 4.82$, $p = .034$) in that males stated more concerns ($M = 2.44$, $SD = 1.8$) than their female counterparts ($M = 1.25$, $SD = .75$). Sex was also related to the number of clues participants considered ($F(1, 37) = 4.37$, $p = .044$) in that females considered more clues ($M = 4.17$, $SD = .58$) than their male counterparts ($M = 3.3$, $SD = 1.9$).

Similar to the categorization of clues described above, the relatively large number of different test orders (35), medication orders (5), and medical concerns (29) had to be further reduced to be able to evaluate decisions statistically. To do so, they were categorized with respect to 'widely used' tests orders and medical concerns (i.e., those used by 34 or more participants) as well as rarely mentioned medical concerns and test orders (i.e., those used by 5 or less participants). Whereas 'widely used' concerns and orders were excluded from statistical analyses due to lack of variability, concerns and orders in the 'rarely used' category were summarized in one dichotomous variable for each outcome type (i.e., medical concerns, medication orders and test orders). For example, '1' denoted

that the participant mentioned at least one of the ‘rare’ medical concerns and ‘0’ denoted that the participant mentioned none of the medical concerns that were summarized under the category of ‘rarely used’ concerns. Test orders and medical concerns that fit in neither the ‘widely-used’ nor the ‘rarely-used’ category were considered as individual outcome variables. In addition, to further reduce the number of different test and medication orders, meaningful compound categories were created. For example, a summary variable was created to denote individual test orders related to ruling out cardiac etiologies (i.e., the Cardiac Panel⁹¹). Another variable was created by summing up the number of orders each participant made with respect to monitoring the patient’s state of health. Similarly, orders of different types of anti-nausea medications were summarized in one dichotomous variable denoting whether or not participants ordered anti-nausea medications. Overall, after applying these procedures, 4 compound and 11 single test orders, 2 compound and 1 individual medical concern, as well as 1 single and 2 compound medication orders remained to be evaluated with respect to the response categories (i.e., the clue categories as well as categories of attitudes/ intentions) identified above. The exact partitioning of the obtained measures of decision outcomes can be found in Appendix V.2-V.4.

Statistical Procedures

Given that the 6 qualitative differences identified in participants’ responses (i.e., SC, C, D, A, S, and R) were statistically independent, main effects as well as all 2-way interactions between each of these categories could be explored. To do so, an ANOVA framework was used to evaluate the effect of categorical independent variables and their interactions with respect to all continuous outcome variables that met the assumptions underlying this framework (i.e., normality and homogeneity of variance)⁹². Given the small

N available for analyses, to increase the degrees of freedom of the error term used for significance testing, all main effects and 2-way interactions with a p -value $> .3$ as well as all effects violating homogeneity of variance assumptions (i.e., $F_{\max} > 3$), and/or cell counts smaller than 3 were excluded from the model. Significant interactions were followed up with tests for simple effects. The non-parametric Kruskal-Wallis test (a statistically extension of the Mann-Whitney U test) was used for continuous variables that did not meet the ANOVA assumptions (i.e., the rank order in which questionnaires were returned). A χ^2 -test of independence was used to evaluate the relationship of the dichotomous response categories on dichotomous/ categorical outcome variables (e.g., specific test or medication orders), using Yates' correction if contingency tables contained expected cell frequencies smaller than 5.

Disclaimer

The analyses performed for this study are exploratory and preliminary in nature because, first, the experimental manipulation to address the first goal of this study (i.e., to disentangle the effect of perceived patient personality on participants' reasoning) was ineffective. Second, although the experimental manipulation was replaced with a conceptually identical distinction, it was identified post-hoc. Third, the second and third goals of this study (i.e., to cross-validate and extend the findings based on observational data) were generally exploratory in nature. To be able to gauge the quantitative patterns in the obtained data and evaluate their (statistical) relationships with the response categories, exact two-tailed p -values will be reported instead of the traditionally used 'cut-off' values at $p = .05$ or $p = .01$. In general, to reduce the complexity and amount of the displayed data,

only results with a p -value $< .3$ will be included in the ANOVA models and contingency tables.

Results by Type of Dependent Measure

Demographics

First, the categorical differences identified in participants' responses were analyzed with respect to their relationships with demographic variables. To report the results with respect to demographic variables as well as throughout the remainder of the result section, two kinds of tables will be used. As can be seen in Table 13, one type will be a contingency table (only those with p -values $< .3$) between categorical dependent measures (columns) and the qualitative differences in participants' responses (rows).

Table 13

Relationships between Response Categories and Demographics

<i>Response category</i>	<i>Demographic Variables</i>					
	Sex		Tenure as Resident			
	Male	Female	1-year	2-year	3-year	1+2-year 3-year
Stoic character clue	$\chi^2(2)^1 = 2.48, p = .289$					
Not used	12	10	7	4	6	
Used	2	2	6	22	7	
Contextual clues	$\chi^2(2) = 4.49, p = .106$					
Not used	11	7	5			
Used	3	5	8			
Demographic clues						
Appearance clue	$\chi^2(2)^1 = 3.55, p = .170$					
Not used	9	6	12			
Used	5	6	1			
Cautious attitude						
Rapport Intentions						

Note: p = probability value.

¹Yates' χ^2 was used to correct for expected cell frequencies smaller than 5.

For demographic categories (i.e., sex and tenure as an ED resident), results indicated that all categorical differences identified in participants' responses were unrelated to both participants' sex and their tenure as ED resident physicians. However, more in-

depth analyses revealed a marginally significant relationship between tenure as ED resident and the use of information about the patient's stoic character. Whereas 6 of the 10 or 60% of the participants who did not use information about the patient's stoic character were third-year residents, only 7 of the 29 or 24% of the participants who considered this information were third-year residents (Yates' $\chi^2(1) = 2.84, p = .091$; Fisher's exact test $p = .048$).

Table 14

ANOVA Model comparing Response Categories with Respect to Age

ANOVA Model	Dependent Measure		
Response Categories	Age		
	df	<i>F</i>	<i>p</i>
Stoic character clue (SC)			
Contextual clues (C)	1	3.14	.086
Demographic clues (D)			
Appearance clue (A)			
Cautious attitude (S)	1	2.32	.138
Rapport (R)			
SC x C			
SC x D			
SC x A			
SC x S			
SC x R			
C x D			
C x A	1	2.13	.115
C x S			
C x R			
D x A			
D x S			
D x R			
A x S			
A x R			
S x R			
Error	33		

Note: x = interaction between respective response categories. df = degrees of freedom. *F* = F-value. *p* = probability value. * $p < .05$, ** $p < .01$

A second type of table will be used to display the results of the 2^6 ANOVAS (see Table 14) relating the model components (i.e., all main effects pertaining to the identified response categories, their 2-way interactions, as well as the error term displayed in rows) with the degrees of freedom, F -values, and p -values for continuous dependent measures such as age (displayed in columns). As stated above, only those main effects and interactions with a p -value $< .3$ are included in the model.

As can be seen from Table 14, the identified response categories were largely unrelated to participants' age. There was only a marginally significant effect for the dichotomous category reflecting whether or not participants used contextual clues in their responses ($F(1, 27) = 3.14, p = .086$). Specifically, participants who used contextual clues in their responses tended to be older ($M = 32.87, SD = 3.70$) than those who did not ($M = 30.65, SD = 4.08$). However, results indicate that demographics were overall unrelated to the identified response categories.

Covariate scale measures

Next, the identified response categories were assessed with respect to three covariate measures: The *order in which participants returned their surveys* as well as the *Mindfulness/ Mindlessness Scale* (MMS) and a revised, short version of the *Health Care Climate Questionnaire* (HCCQ), which were both obtained at the end of the survey study. First, participants' return rank (i.e., the relative time of completion of both the exam and the experiment) was assessed with respect to the identified response categories. Results revealed that participants who did *not* reason about the patient's stoic character returned their survey, relative to those participants who reasoned about the patient's stoic behavior,

either at the beginning or end of the experiment ($\chi^2(2) = 15.64, p = .001^{93}$). Specifically, of the 10 participants who did *not* consider the patient's stoic character, 6 were among the first 9 and the remaining 4 were among the last 13 participants who returned the filled-out survey. Further, the super-category denoting whether or not participants used non-medical clues (i.e., reasoned about the patient's stoic character and/or considered 'other' contextual clues) was related to participants' return rank ($\chi^2(1) = 6.08, p = .009$). Specifically, 5 of the 6 participants who did not use any non-medical clue were among the first 9 participants who returned their survey. The only other category, which was marginally related to the return rank, was whether or not participants used demographic clues in their responses ($\chi^2(1) = 2.59, p = .108$). Participants who use this type of clue tended to return their survey earlier relative those who did not. There was a significant effect for the super-category denoting whether or not participants used epidemiological clues ($\chi^2(1) = 5.27, p = .022$). Participants who considered demographic clues *and/or* the patient's physical appearance returned their surveys earlier than those who did not.

Next, the results for the MMS were assessed. As can be seen from Table 15, there were two main effects. The first main effect pertained to the category reflecting whether or not participants' responses reflected a 'cautious' attitude ($F(1,33) = 5.67, p = .023$) in that participants with a 'cautious' attitude scored significantly higher on the MMS ($M = 119.9, SD = 10.2$) than those without responses reflecting such an attitude ($M = 108.4, SD = 9.8$). The second main effect was related to the category reflecting whether or not participants reasoned about the patient's stoic character ($F(1,33) = 4.71, p = .037$) in that participants who considered the patient's stoic behavior scored significantly higher on the MMS ($M =$

112.52, $SD = 10.2$) than those who did not ($M = 107.3$, $SD = 12.7$). More detailed analyses of the subscales of the MMS can be found in Appendix V.5.

Table 15

ANOVA Model comparing Response Categories with respect to Covariate Measures

ANOVA Model Response Categories	Covariate Scale Measures					
	Mindfulness/ Mindlessness Scale			Health Care Climate Questionnaire		
	df	<i>F</i>	<i>p</i>	df	<i>F</i>	<i>P</i>
Stoic character clue (SC)	1	4.71	.037*			
Contextual clues (C)						
Demographic clues (D)						
Appearance clue (A)						
Cautious attitude (S)	1	5.67	.023*	1	8.57	.006**
Rapport (R)						
SC x C						
SC x D						
SC x A						
SC x S						
SC x R						
C x D						
C x A						
C x S						
C x R						
D x A						
D x S	1	2.06	.144			
D x R						
A x S						
A x R						
S x R						
Error	33			36		

Note: x = interaction between respective response categories. df = degrees of freedom. *F* = F-value. *p* = probability value.

* $p < .05$, ** $p < .01$

Finally, with respect to the HCCQ, Table 15 shows that analyses revealed a main effect for the category reflecting whether or not participants' responses reflected a 'cautious' attitude ($F(1,33) = 8.47$, $p = .006$). As for the MMS, participants whose

responses reflected a ‘cautious’ attitude scored significantly higher on the HCCQ ($M = 34.77$, $SD = 2.2$) than those without such responses ($M = 32.48$, $SD = 2.2$).

Participant ratings

Importance ratings. As part of the administered survey, participants were asked to rate the importance of 8 aspects pertaining to the physician-patient interaction with respect to cases such as the one described in the vignette. First, participants rated 4 aspects pertaining to the patient’s side of the interaction: the patient’s ability to *articulate the complaint*, the patient’s *physical symptoms*, *personality*, and *social background*. As can be seen in Table 16, for participants’ importance ratings of *the patient’s ability to articulate the complaint*, there was a main effect for the category reflecting whether or not participants mentioned the implications of the patient’s stoic character in their responses ($F(1,32) = 18.98$, $p = .001$). Specifically, participants who reasoned about the patient’s stoic behavior rated the patient’s ability to articulate the complaint as significantly more important ($M = 9.0$, $SD = 1.0$) than those who did not ($M = 7.5$, $SD = 1.3$). With respect to the importance of *physical symptoms*, there was, after controlling for significant effects of age ($F(1,35) = 7.17$, $p = .011$), a significant main effect of the category denoting whether or not participants considered the patient’s stoic character in their reasoning ($F(1,35) = 14.03$, $p = .001$). That is, participants who considered the patient’s stoic behavior rated the physical symptoms as significantly more important ($M = 8.27$, $SD = 1.1$) than those who did not ($M = 7.2$, $SD = 1.5$).

Next, participants’ rated the importance of the *patient’s personality*. As can be seen, after controlling for significant effects of participants tenure as ED residents ($F(1,32) = 8.16$, $p = .007$), there was a main effect of the category representing whether or not

participants stated intentions to engage in rapport-inducing behaviors ($F(1,32) = 8.92, p = .005$) in that those with intentions rated the patient's personality as less important ($M = 5.41, SD = 2.6$) than those without ($M = 6.31, SD = 1.8$).

Table 16

ANOVA Model comparing Response Categories with respect to Participants' Importance

*Ratings of **PATIENT** Factors in the Physician-Patient Interaction*

ANOVA Model Response Categories	Importance Ratings of PATIENT Factors											
	Ability to articulate			Symptoms (c/f age)			Personality (c/f tenure)			Social background		
	df	<i>F</i>	<i>p</i>	df	<i>F</i>	<i>p</i>	df	<i>F</i>	<i>p</i>	df	<i>F</i>	<i>p</i>
Stoic character (SC)	1	18.98	.001**	1	14.03	.001**				1	6.22	.018*
Contextual clues (C)												
Demographic clues (D)	1	2.12	.155									
Appearance clue (A)												
Cautious attitude (S)				1	1.86	.181				1	3.83	.059
Rapport (R)							1	8.92	.005**	1	5.62	.024*
SC x C												
SC x D												
SC x A												
SC x S												
SC x R							1	3.90	.031*	1	9.95	.003**
C x D												
C x A												
C x S												
C x R												
D x A												
D x S												
D x R												
A x S	1	2.53	.074									
A x R							1	2.07	.143			
S x R												
Covariate				1	7.17	.011*	1	8.16	.007**			
Error	33			35			32			33		

Note: x = interaction between respective response categories. df = degrees of freedom. *F* = F-value. *p* = probability value.

* $p < .05$, ** $p < .01$

In addition, there was a significant interaction between the categories denoting the use of the patient's stoic behavior as well as intentions to engage in rapport-inducing

behaviors ($F(1,32) = 3.90, p = .039$). As can be seen from Figure 4, participants who did not consider the patient's stoic character but stated intentions to engage in rapport-inducing behaviors judged the patient's personality significantly less important than those participants who neither considered the patient's stoic character nor stated intentions to engage in rapport-inducing behaviors ($F(1,24) = 4.34, p = .048$).

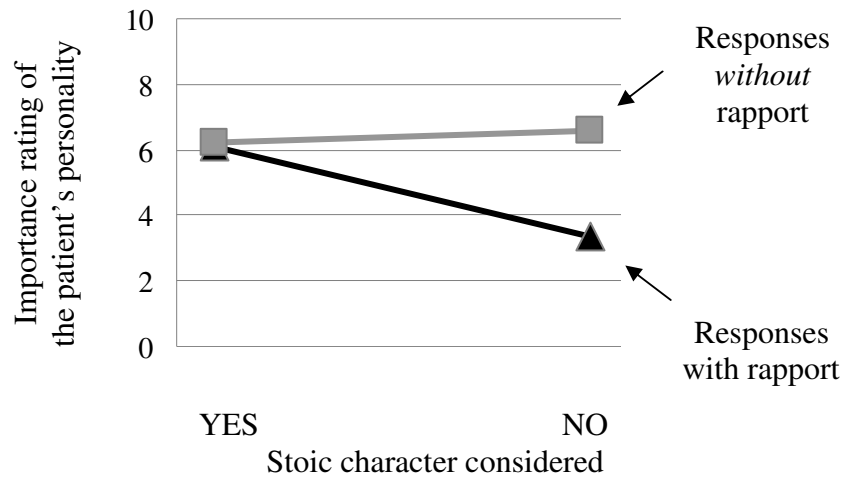


Figure 4. Plot of the statistical interaction between participants' reasoning about the patient's stoic character (YES versus NO) and whether or not they stated intentions to engage in rapport-inducing behaviors with respect to how important participants rated the patient's personality. Grey square symbols reflect participants without rapport-related responses whereas black triangles stand for participants with rapport-related responses.

For the importance rating of the final patient factor – the *patient's social background* – there were main effects for both the category reflecting whether or not the participant considered the patient's stoic character ($F(1,33) = 6.22, p = .018$)⁹⁴ as well as the category reflecting whether participants stated intentions to engage in rapport-inducing behaviors ($F(1,33) = 5.62, p = .024$)⁹⁵. Similar to the importance rating of the patient's personality, there was also a significant interaction between these two categories ($F(1,33) = 9.95, p = .003$). Specifically, similar to the pattern in Figure 4, Figure 5 shows that participants who did not consider the patient's stoic character but stated intentions to

engage in rapport-inducing behaviors judged the patient's personality significantly less important than those participants who considered the patient's stoic character *and* stated their intentions to engage in rapport-inducing behaviors ($F(1,23) = 5.27, p = .031$).

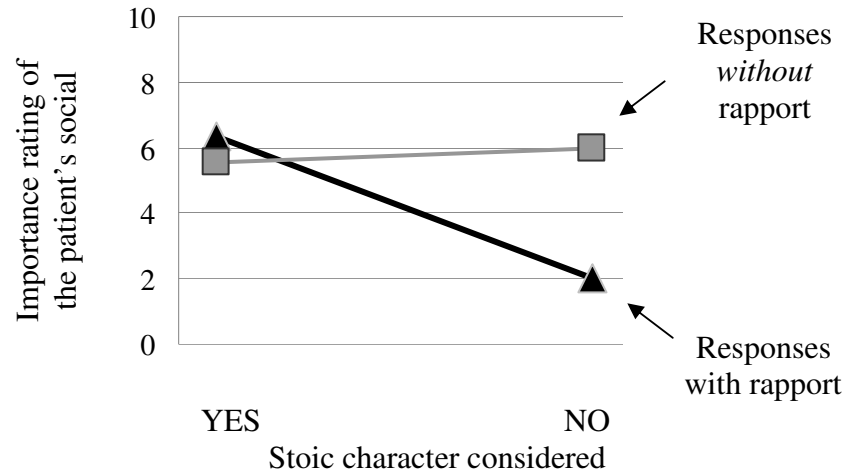


Figure 5. Plot of the statistical interaction between participants' reasoning about the patient's stoic character (YES versus NO) and whether or not they stated intentions to engage in rapport-inducing behaviors with respect to how important participants rated the patient's social background. Grey square symbols reflect participants without rapport-related responses whereas black triangles stand for participants with rapport-related responses.

Second, participants were asked to rate the importance of 4 physician factors pertaining to the physician-patient interaction: physicians' *listening skills*, *medical expertise*, *intuition*, and *people skills*. As can be seen in Table 17, the importance ratings of physicians' factors were largely unrelated to the identified response categories. There was only one main effect for participants' importance ratings of physicians' *medical expertise* for the category reflecting whether or not participants responses reflected a 'cautious' attitude ($F(1,30) = 6.01, p = .020$). Specifically, participants with a 'cautious' attitude rated physicians' medical expertise as significantly less important ($M = 7.59, SD = 1.3$) than those without such an attitude ($M = 8.54, SD = 1.3$).

Table 17

ANOVA Model comparing Response Categories with respect to Participants' Importance

*Ratings of **PHYSICIAN** Factors in the Physician-Patient Interaction*

ANOVA Model		Importance Ratings of <i>PHYSICIAN</i> Factors										
Response Categories	Listening skills			Medical expertise			Intuition			People skills		
	df	<i>F</i>	<i>p</i>	df	<i>F</i>	<i>p</i>	df	<i>F</i>	<i>p</i>	df	<i>F</i>	<i>p</i>
Stoic character (SC)												
Contextual clues (C)												
Demographic clues (D)												
Appearance clue (A)							1	1.78	.190	1	2.46	.126
Cautious attitude (S)	1	1.65	.208	1	6.01	.020*						
Rapport (R)												
SC x C				1	2.91	.069						
SC x D												
SC x A												
SC x S												
SC x R				1	3.70	.064						
C x D												
C x A												
C x S												
C x R	1	2.09	.140									
D x A												
D x S												
D x R												
A x S												
A x R										2	1.96	.156
S x R	1	2.29	.140									
Error	33			30			37			34		

Note: x = interaction between respective response categories. df = degrees of freedom. *F* = F-value. *p* = probability value. * *p* < .05, ** *p* < .01

Probability judgments. In addition to importance ratings, participants were also asked to provide 2 *probability judgments* (in percentages between 0% – 100%) of how likely the described patient required a full admission (the first judgment) and admission for 23 hours of observation (the second judgment). Table 18 summarizes the findings for these

participant ratings with respect to the identified responses categories. As can be seen, whereas there was no main effect for participants' judgments of how likely the described patient required full admission, there were two main effects with respect to participants' judgments of how likely the described patient required admission for 23 hours of observation. One main effect pertained to the category denoting whether or not participants reasoned about the implications of the patient's stoic character ($F(1,26) = 4.71, p = .039$). Specifically, analyses revealed that participants who considered the patient's stoic character judged it less likely that the patient would require admission for observation ($M = 79.0, SD = 18.8$) than those participants who did not reason about the patient's stoic behavior ($M = 86.5, SD = 11.8$). The second main effect was associated with the category reflecting whether or not participants' responses reflected a 'cautious' attitude ($F(1,26) = 4.47, p = .044$) in that participants with a 'cautious' attitude judged admission for 23 hours of observation as less likely ($M = 71.87, SD = 26.0$) than those without ($M = 83.89, SD = 12.7$).

Apart from these main effects for the judgment of how likely the patient required admission for observation, there were significant interactions for both judgment tasks between the categories denoting whether or not participants considered the patient's stoic character and whether or not their responses reflected a 'cautious' attitude. Specifically, the two graphs in Figure 6 show that participants who did not make statements reflecting a 'cautious' attitude provided similar probability judgments independently of whether or not they considered the patient's stoic behavior. On average, these participants associated the patient's complaint with a circa 50% chance for a full admission compared to a circa 30% greater chance (about 80%) for an admission for 23 hours of observation. On the other

hand, participants with ‘cautious’ responses differed in their judgment depending on whether or not they included the patient’s stoic character in their reasoning. That is, those participants with cautious responses who also included the patient’s stoic behavior in their reasoning, judged the patient’s probability for a full admission significantly higher (64.8%) than those who did not consider the patient’s stoic behavior (31.7%) ($F(1,20) = 5.06, p = .036$).

Table 18

ANOVA Model comparing Response Categories with respect to Probability Judgments

ANOVA Model Response Categories	Probability judgments					
	Probability of FULL admission			Probability of admission for OBSERVATION		
	df	F	P	df	F	P
Stoic character clue (SC)				1	4.71	.039*
Contextual clues (C)	1	2.28	.143			
Demographic clues (D)						
Appearance clue (A)						
Cautious attitude (S)				1	4.47	.044*
Rapport (R)						
SC x C						
SC x D	1	3.68	.066			
SC x A				1	1.68	.206
SC x S	1	4.91	.036*	1	12.81	.001**
SC x R						
C x D						
C x A	1	2.48	.127			
C x S	1	2.45	.129			
C x R						
D x A						
D x S						
D x R						
A x S						
A x R						
S x R						
Error	26			26		

Note: x = interaction between respective response categories. df = degrees of freedom. F = F-value. p = probability value.

* p < .05, ** p < .01

The relationship is reversed for the judgment of how likely the described patient required admission for observation. Participants who both reasoned about the patient's stoic character *and* provided responses reflecting a 'cautious' attitude judged the probability that the patient will be admitted for observation lower (49%) compared to participants with only a 'cautious' attitude (93.3%) ($F(1,19) = 20.14, p = .001$) as well as participants who considered the patient's stoic character but did *not* explicitly state their 'cautious' attitude (84%) ($F(1,19) = 13.71, p = .002$). In other words, whereas the latter group of participants thought it was more likely the patient was going to be admitted for observation the former group perceived it as more likely that the patient would need full admission.

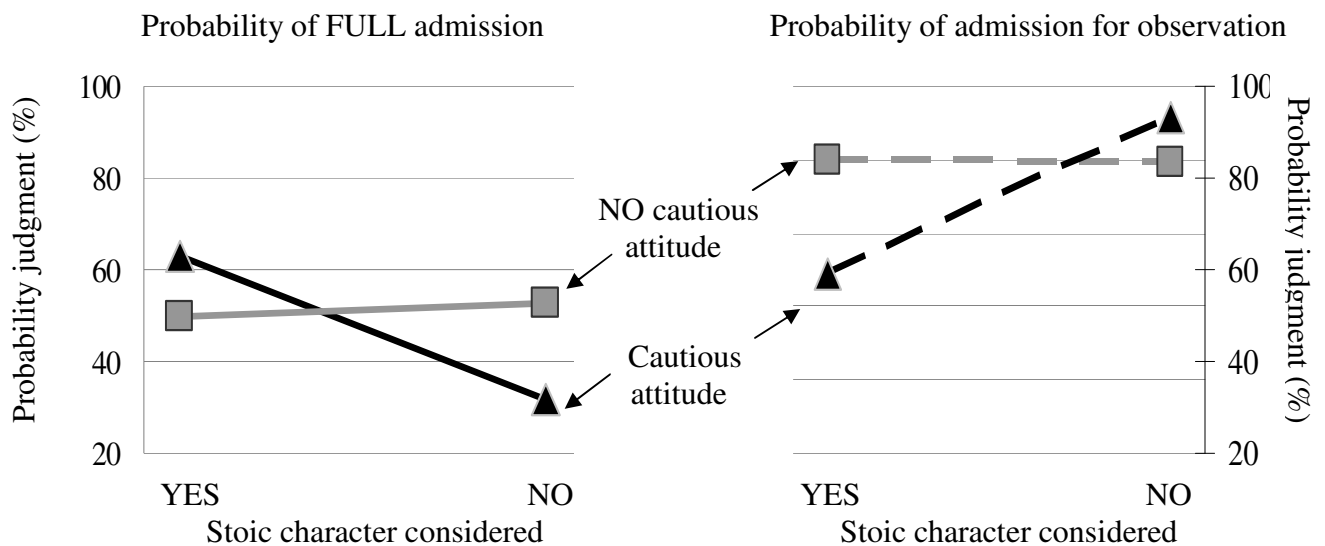


Figure 6. Plots of statistical interactions between participants' reasoning about the patient's stoic character (YES versus NO) and whether or not their responses reflected a 'cautious' attitude with respect to probability judgments for full admission (plot on the left with solid lines) and admission for observations (plot on the right with dashed lines). Grey squares reflect the absence whereas black triangles represent presence of a 'cautious' attitude in participants' responses.

Clinical knowledge

Next, response categories were evaluated with respect to participants' scores on a comprehensive in-training examination designed to measure resident physicians'

knowledge in all relevant areas of emergency medicine. As can be seen from Table 19, after controlling for participants' tenure as ED resident physicians ($F(1,25) = 11.04, p = .003$), there was one additional significant main effect for the category denoting whether or not participants reasoned about the patient's physical appearance ($F(1,25) = 9.74, p = .005$) and one marginally significant main effect for whether or not participants' responses reflected a 'cautious' attitude ($F(1,25) = 4.21, p = .051$). Specifically, participants who referred to the patient's physical appearance when reasoning about the complaint obtained lower scores on the exam ($M = 71.67, SD = 8.5$) than participants who did not ($M = 74.63, SD = 8.6$). Conversely, there was a trend for participants with responses that reflected a 'cautious' attitude to score slightly higher on the exam ($M = 74.36, SD = 11.7$) than those participants without such responses ($M = 73.46, SD = 7.3$).

Given the exploratory nature of the present analyses, the identified interactions will not be interpreted with respect to group differences in performance. Instead, it may be conceptually more meaningful to interpret the identified interactions with respect to the clues, attitudes, and intentions that were used by the highest versus lowest performing group of participants, respectively. That is, groups of highest versus lowest performers were compared for each interaction separately. First, two interactions will be used to illustrate the kinds of clues groups of high performing participants tended *NOT* to use.

The left graph in Figure 7 displays the interaction between the categories denoting whether or not participants responses reflected intentions to engage in rapport-inducing behavior and whether or not they considered the patient's physical appearance in their responses ($F(1,25) = 11.02, p = .003$). An almost identical pattern can be found for the interaction between the category reflecting whether or not participants used contextual

clues and/or the patient's physical appearance ($F(1,25) = 7.99, p = .009$). Due to this similarity, the latter interaction will not be displayed.

Table 19

ANOVA Model comparing Response Categories to Participants' Clinical knowledge

ANOVA Model	Performance Measure		
Response Categories	Exam Score (c/f tenure)		
	df	<i>F</i>	<i>P</i>
Stoic character clue (SC)			
Contextual clues (C)			
Demographic clues (D)			
Appearance clue (A)	1	9.74	.005**
Cautious attitude (S)	1	4.21	.051
Rapport (R)			
SC x C			
SC x D			
SC x A			
SC x S	2	7.75	.002**
SC x R			
C x D			
C x A	1	7.99	.009**
C x S	1	4.18	.052
C x R	1	4.70	.040*
D x A	2	2.91	.073
D x S			
D x R			
A x S			
A x R	1	11.02	.003**
S x R			
Tenure as Resident	1	11.04	.003**
Error	25		

Note: x = interaction between respective response categories.

df = degrees of freedom. *F* = *F*-value. *p* = probability value.

* $p < .05$, ** $p < .01$

As can be seen in the left graph in Figure 7, whereas the highest performing group provided responses that reflected intentions to engage in rapport-inducing behavior but did *not* consider the patient's physical appearance, the lowest performing group considered

both factors in their responses. The difference in their performance score was statistically significant ($F(1,24) = 12.20, p = .002$). The performance difference between the group that used neither the patient's physical appearance nor stated intentions to engage in rapport-related behavior and the highest performing group (participants with rapport intentions *only*) was marginally significant ($F(1,24) = 4.10, p = .054$).

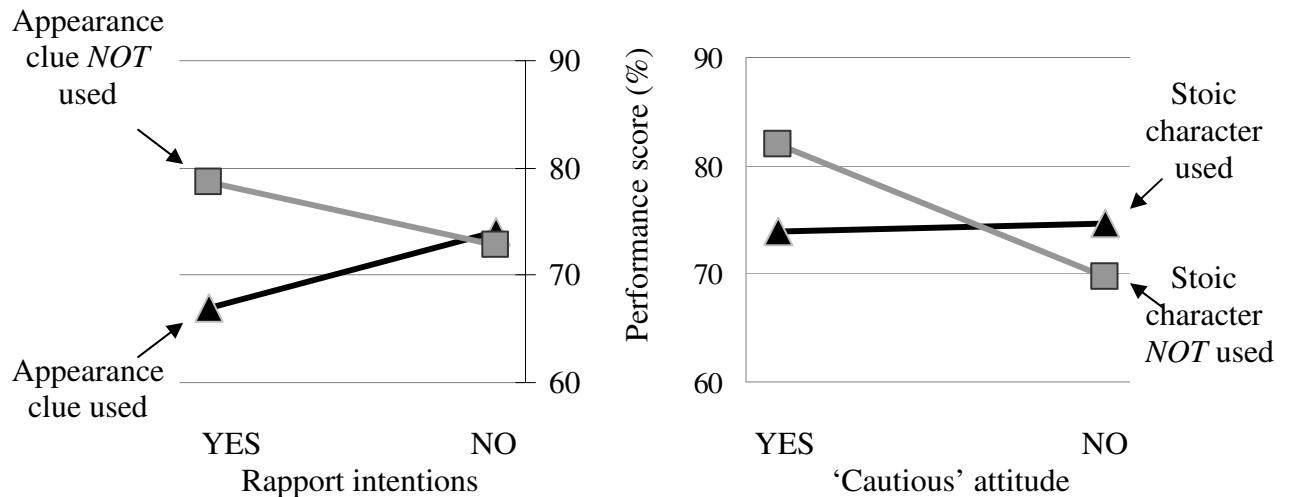


Figure 7. The left graph displays the statistical interaction between participants' intentions to engage in rapport-inducing behavior (YES or NO) and whether or not they used the patient's physical appearance in the responses with respect to their score (percentage value) on the in-training exam. The right graph displays the interaction between participants' with versus without a 'cautious' attitude and whether or not they considered the patients' stoic character with respect to their exam score. Grey squares reflect the use whereas black triangles stand for the omission of the patient's appearance/ stoic character.

The right graph in Figure 7 displays the interaction between the categories denoting whether or not participants responses reflected a 'cautious' attitude and whether or not they considered the patient's stoic character in their responses ($F(2,25) = 7.75, p = .002$). As can be seen, the highest performing group provided responses that reflected a 'cautious' attitude but did *not* consider the patient's stoic character in their responses. Conversely, the lowest performing group neither considered the patient's stoic character nor provided responses explicitly stating a 'cautious' attitude. The difference in the performance scores between these two groups was statistically significant ($F(1,24) = 8.01, p = .009$). In

addition, there was a significant performance difference between the highest performing group and the group that mentioned both the patient's stoic character *as well as* a 'cautious' attitude in their responses ($F(1,24) = 5.41, p = .029$). That is, participants who also mentioned the patient's stoic character scored on average lower than the highest performers who relied on a 'cautious' attitude only. Next, the interactions displayed in Figure 8 will be used to illustrate the type of clues groups of high performing participants tended to use.

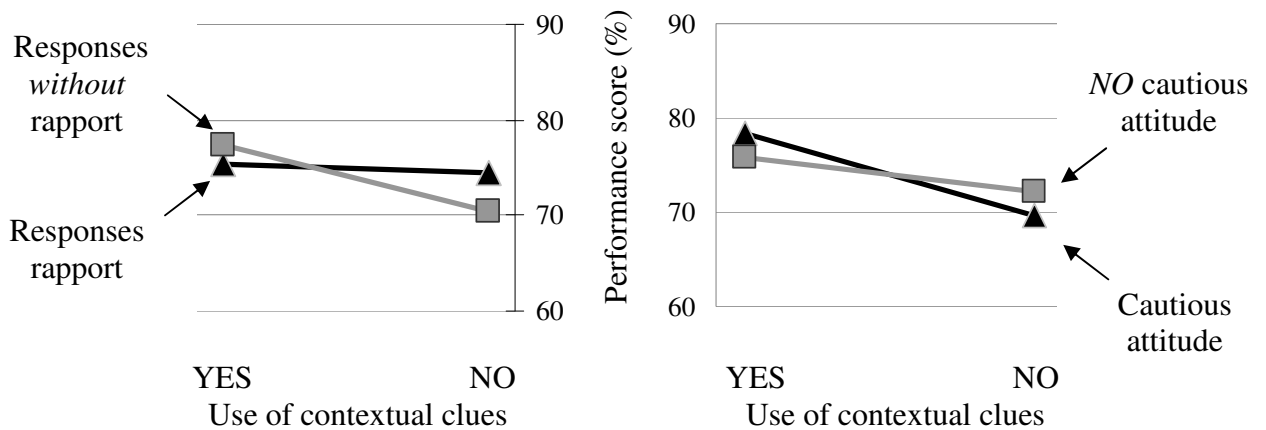


Figure 8. The left graph displays the statistical interaction between participants' use of contextual clues (YES or NO) and whether or not they stated intentions to engage in rapport-inducing behavior with respect to their score on the in-training exam. The right graph displays the interaction between participants' use of contextual clues (YES or NO) and whether they provided responses with versus without a 'cautious' attitude with respect to their exam score. Grey squares reflect the absence whereas black triangles stand for the presence of a 'cautious' attitude /rapport-related responses.

The left graph in Figure 8 displays the interaction between the categories denoting whether or not participants stated intentions to engage in rapport-inducing behavior and whether or not they used contextual clues ($F(1,25) = 4.67, p = .040$). As can be seen, the highest performing group used contextual clues *only* whereas the lowest performing group used neither contextual clues nor stated intentions to engage in rapport-inducing behavior. The difference in performance scores between these two groups was statistically significant ($F(1,23) = 7.17, p = .013$). In addition, the performance difference between the group that stated intentions to engage in rapport-related behavior but did *not* use contextual clues and

the lowest performing group (i.e., participants who used neither contextual clues nor stated rapport-related intentions) was significant ($F(1,22) = 4.55, p = .044$).

The right graph in Figure 8 displays the marginally significant interaction between the categories denoting whether or not participants responses reflected a ‘cautious’ attitude and whether or not they used contextual clues in their responses ($F(1,24) = 4.18, p = .052$). As can be seen, the highest performing group provided responses that reflected a ‘cautious’ attitude *and* used contextual clues. The lowest performing group, on the other hand, stated a ‘cautious’ attitude but did *not* consider contextual clues. The difference in the performance score between these two groups was marginally significant ($F(1,23) = 4.21, p = .052$). In sum, groups of highest compared to lowest performers on the knowledge exam used contextual clues but did *not* use information about the patient’s physical appearance or stoic character. In addition to the use of contextual cues, groups of highest compared to lowest performers also provided responses that reflected a ‘cautious’ attitude. For those participants who did not use contextual clues, groups of higher performing participants stated intentions to engage in rapport-inducing behavior.

Measures of evaluation and treatment decisions

Finally, response categories were investigated with respect to measures of evaluation and treatment decisions. Before assessing categorical/dichotomous measures (i.e., the presence or absence of certain classes of test and medication orders), continuous measures were assessed such as the *number of clues* participants used in their responses, the *number of medical concerns* they stated as well as the *number of tests/studies* and *medications ordered*.

Table 20

*ANOVA Model Comparing Response Categories with Respect to Evaluation and Treatment**Decisions*

ANOVA Model			Measures of decision outcomes									
Response Categories	# of clues used in responses (c/f sex)			# of medical concerns (c/f sex)			# of tests/studies ordered			# of medications ordered (c/f sex)		
	<i>df</i>	<i>F</i>	<i>p</i>	<i>df</i>	<i>F</i>	<i>p</i>	<i>df</i>	<i>F</i>	<i>p</i>	<i>df</i>	<i>F</i>	<i>p</i>
Stoic character (SC)	1	2.04	.163				1	2.14	.154			
Contextual clues (C)	1	5.91	.021*									
Demographic clues (D)							1	13.93	.001**			
Appearance clue (A)							1	2.03	.164			
Cautious attitude (S)	1	5.55	.025*				1	5.58	.025*	1	3.29	.079
Rapport (R)				1	4.55	.043*	1	6.78	.014*			
SC x C				1	8.46	.008**				1	3.30	.032*
SC x D	1	2.92	.069	1	5.50	.027*	1	6.65	.015*			
SC x A												
SC x S	1	10.52	.003**	1	2.03	.167						
SC x R				1	6.30	.019*						
C x D												
C x A												
C x S				1	1.91	.180						
C x R												
D x A							1	2.65	.114			
D x S				1	2.43	.131						
D x R							1	3.23	.083			
A x S												
A x R												
S x R				1	2.59	.120						
Sex (Covariate)	1	10.89	.002**	1	1.56	.224				1	9.74	.004**
Error	31			25			30			33		

Note: x = interaction between respective response categories. *df* = degrees of freedom. *F* = F-value. *p* = probability value.

* $p < .05$, ** $p < .01$

Continuous measures of evaluation and treatment decisions. First, the number of clues was assessed with respect to the response categories. As can be seen from Table 20, after controlling for sex differences ($F(1,31) = 10.89$, $p = .002$), the category denoting

whether or not participants used contextual clues as well as whether or not their responses reflected a ‘cautious’ attitude were related to how many clues were used. Specifically, participants who used contextual clues ($F(1,31) = 5.91, p = .021$) used more clues overall ($M = 3.88, SD = .9$) than those who did not ($M = 3.35, SD = 1.4$). Similarly, participants with a ‘cautious’ attitude ($F(1,31) = 5.55, p = .025$) used more clues overall ($M = 3.63, SD = 1.1$) than those without ($M = 3.53, SD = 1.3$). In addition, there was a significant interaction between the category reflecting whether or not participants reasoned about the patient’s stoic character and whether or not their responses reflected a ‘cautious’ attitude ($F(1,31) = 10.52, p = .003$). As shown in Figure 9, participants who provided responses reflecting a ‘cautious’ attitude but did *not* consider the patient’s stoic character used more clues than participants who neither reasoned about the patient’s stoic behavior nor displayed a ‘cautious’ attitude ($F(1,26) = 5.76, p = .024$).

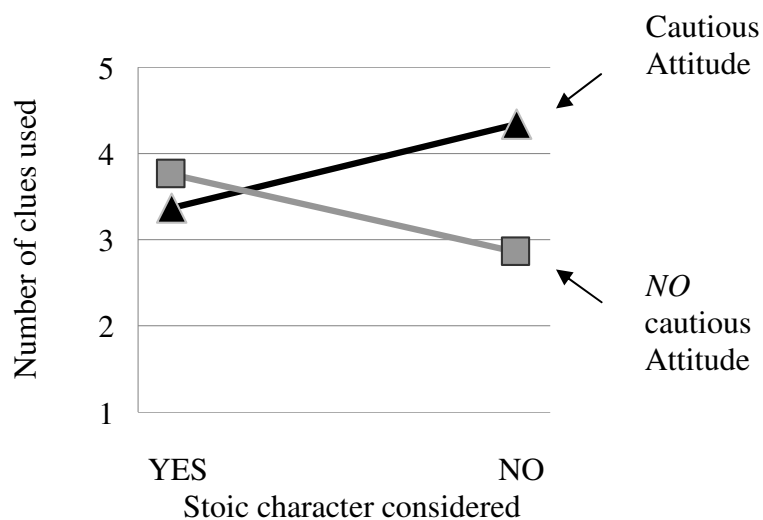


Figure 9. Plot of the statistical interaction between participants’ reasoning about the patient’s stoic character (YES versus NO) and whether or not their responses reflected a ‘cautious’ attitude with respect to the overall number of clues in their responses. Grey square symbols reflect participants without a ‘cautious’ attitude whereas black triangles stand for participants with a ‘cautious’ attitude.

Second, with respect to the *number of medical concerns* stated, there was a main effect of whether or not participants stated intentions to engage in rapport-inducing behaviors ($F(1,25) = 4.55, p = .043$) in that participants with such intentions stated fewer concerns ($M = 1.25, SD = .6$) than those without ($M = 2.44, SD = 1.8$). Moreover, there were three significant interactions all involving the response category denoting whether or not participants considered the patient's stoic character in their reasoning. As can be seen in Figure 10, there are two patterns associated with these interactions.

On the left side of Figure 10, the first pattern is described by the interaction between the category denoting whether or not participants considered the patient's stoic character and whether or not they used contextual clues ($F(1,25) = 8.46, p = .008$)⁹⁶. Particularly, participants who neither considered the patient's stoic behavior nor used contextual clues stated significantly more medical concerns than those who considered either the patient's stoic character ($F(1,20) = 9.27, p = .006$) or contextual clues ($F(1,20) = 4.11, p = .056$) alone. In other words, those participants who used at least one non-medical clue (either a contextual clue or the patient's stoic behavior) stated fewer medical concerns in their responses than those who used neither. On the other hand, the second pattern on the right side of Figure 10 shows that this relationship changed when participants used demographic instead of contextual clues. Specifically, participants' who did not consider the patient's stoic character (independently of whether or not they used demographic information) stated significantly more concerns than those who considered *both* the patient's stoic behavior *and* his demographics ($F(1,14) = 8.84, p = .010$). That is, whereas the use of non-medical clues (i.e., the patient's stoic behavior and 'other' contextual clues) seemed to help participants reduce the number of medical concerns to be considered,

demographic clues such as sex and age had a similar effect but only if considered together with information about the patient's stoic demeanor.

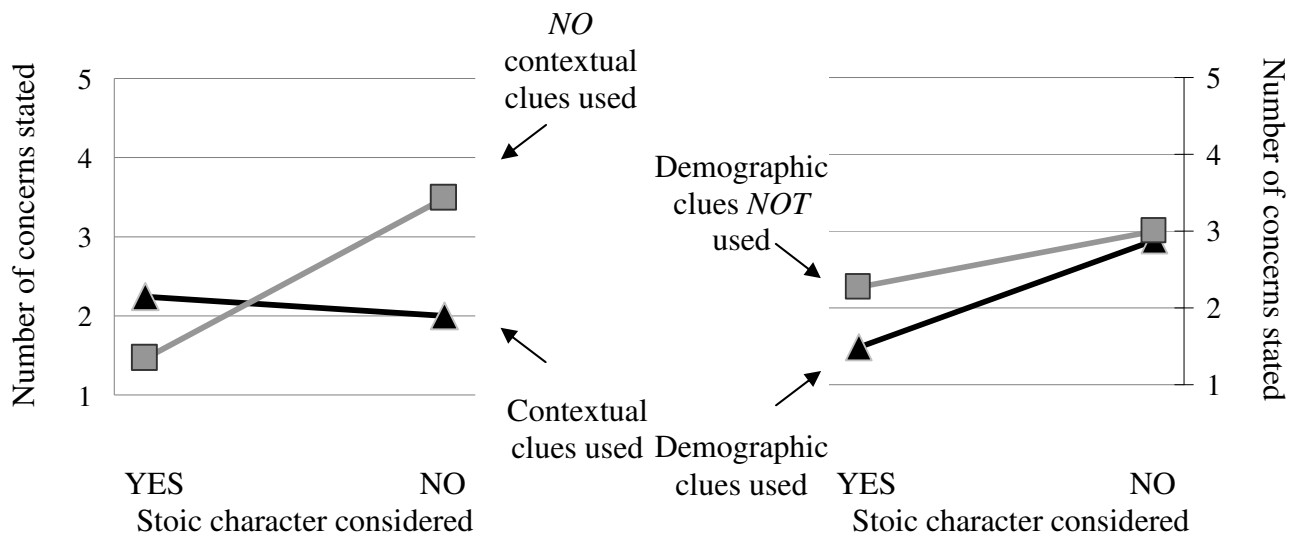


Figure 10. The left graph displays the statistical interaction between participants' reasoning about the patients' stoic character and whether or not they used contextual clues with respect to number of medical concerns stated in their responses. The right graph displays the interaction between participants' use of reasoning about the patients' stoic character and whether or not participants used demographic clues in their responses. Grey squares reflect the absence whereas black triangles stand for the presence of contextual/demographic clues in participants' responses.

Third, the *number of test/study orders* was assessed with respect to the identified response categories. As can be seen from Table 20, there were three main effects. The first main effect was related to participants' use of demographic clues ($F(1,30) = 13.93, p = .001$) in that participants who used this information ordered significantly fewer medical tests/studies ($M = 9.04, SD = 2.6$) than those who did not ($M = 11.08, SD = 3.3$). Conversely, those participants whose responses reflected a 'cautious' attitude ordered more tests/studies ($M = 10.82, SD = 2.8$) than those without such responses ($M = 9.29, SD = 3.0$). Similarly, those participants who stated intentions to engage in rapport-inducing behaviors order more tests ($M = 10.75, SD = 2.5$) than those who did not ($M = 9.26, SD = 3.1$).

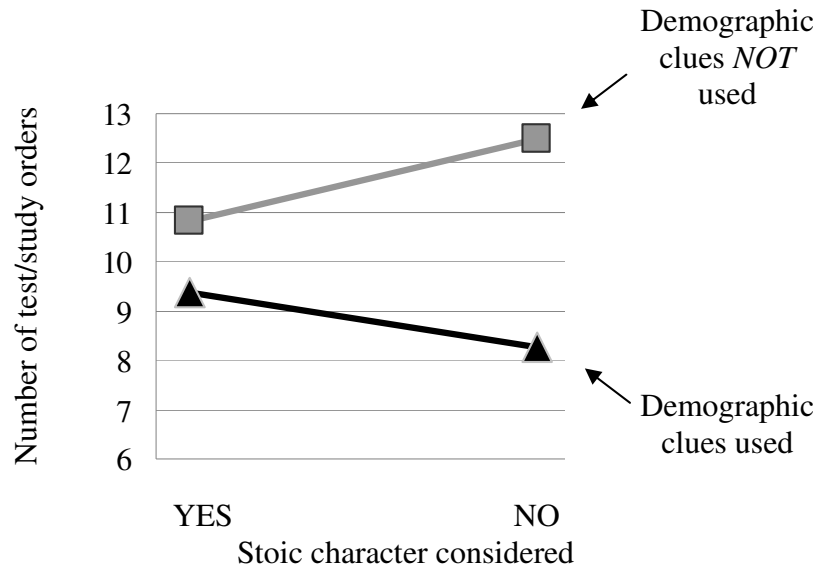


Figure 11. Plot of the statistical interaction between participants' reasoning about the patient's stoic character (YES versus NO) and whether or not they used demographic clues in their responses with respect to the overall number of test/study order made. Grey square symbols reflect participants who did not use demographic clues whereas black triangles stand for participants with used demographic clues in their responses.

In addition, there was one significant interaction between the categories denoting whether or not participants reasoned about the patient's stoic character and whether or not they used demographic clues in their responses ($F(1,30) = 6.65, p = .015$). Specifically as displayed in Figure 11, participants who used neither demographic clues nor information about the patient's stoic behavior ordered more tests than those participants who used demographic clues alone ($F(1,20) = 5.07, p = .036$).

Finally, the *number of medication orders* was assessed with respect to the identified response categories. As can be seen from Table 20, after controlling for significant sex differences ($F(1,31) = 9.74, p = .004$), there was a significant interaction between the categories denoting whether or not participants reasoned about the patient's stoic character and whether or not they used contextual clues ($F(1,33) = 3.30, p = .032$).

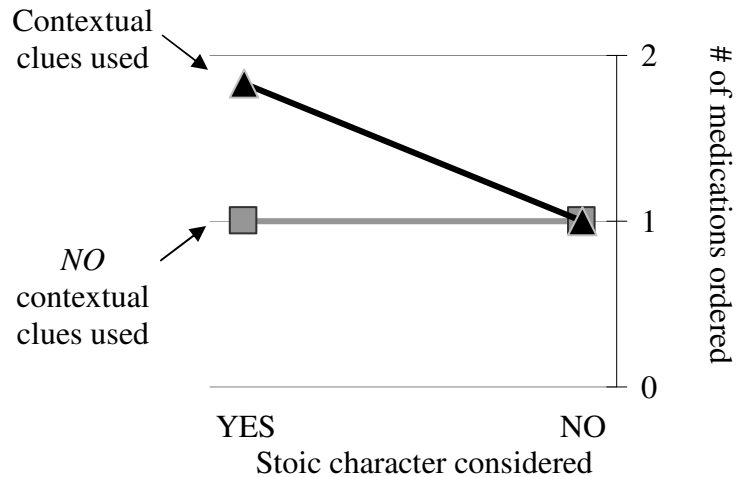


Figure 12. Plot of the interaction between participants' reasoning about the patient's stoic character (YES versus NO) and their use of contextual clues with respect to the number of medications ordered. Grey squares reflect the absence whereas black triangles stand for the presence of contextual clues in participants' responses.

Specifically, Figure 12 shows that participants who reasoned about both the patient's stoic character as well as 'other' contextual clues ordered significantly more medications than participants who used none or only one kind of contextual clues (i.e., only 'other' contextual clues: $F(1,31) = 5.41, p = .027$; only stoic character: $F(1,31) = 5.52, p = .025$).

Categorical/dichotomous measures of evaluation and treatment decisions. As stated at the outset, the large number of different medical concerns stated (29) as well as test (35) and medication orders (5) identified in participants' responses required grouping and classification of these categorical/dichotomous measures into a more manageable number of compound variables. First, differences in 4 classes of *medical concerns* (presence/absence) were evaluated with respect to identified responses categories: concerns about cardiac etiologies⁹⁷, gastrointestinal etiologies⁹⁸, aortic dissection, and infrequent etiologies⁹⁹. Table 21 summarizes contingency tables between these classes of concerns (in columns) and the identified response categories (in rows). Although an important finding,

concerns about cardiac etiologies are omitted from Table 21 due to lack of variability. That is, all but two participants stated cardiac etiologies as the most important medical concern to be ruled out during an evaluation in the ED.

As can be seen from Table 21, only one statistically significant difference could be identified with respect to the category denoting whether or not participants responses reflected intentions to engage in rapport-inducing behaviors (Yates' $\chi^2(1) = 4.95, p = .026$). Specifically, none of the 12 participants who mentioned such intentions in their responses speculated about etiologies that were classified as infrequent medical concerns (for a detailed list of infrequent concerns see Appendix V.2). On the other hand, infrequent medical concerns were mentioned by 11 out of 29 or 37.9% of those participants whose responses did *not* reflect intentions to engage in rapport-inducing behaviors.

Table 21

Contingency Tables between Response Categories and Medical Concerns

<i>Response Category</i>		<i>Medical Concerns</i>					
		GI etiologies		Aortic Dissection		Infrequently stated etiologies	
		Absent	Present	Absent	Present	Absent	Present
Stoic character clue							
Contextual clues		$\chi^2(1) = 2.00, p = .157$					
	Not used	19	4				
	Used	10	5				
Demographic clues							
	Not used					$\chi^2(1) = 3.10, p = .078$	
						7	6
	Used					21	5
Appearance clue							
Cautious attitude		$\chi^2(1)^1 = 1.87 p = .171$					
	Not used	23	5				
	Used	6	5				
Rapport intentions							
	Not used					$\chi^2(1)^1 = 4.95, p = .026^*$	
						16	11
	Used					12	0

Note: ¹Yates' χ^2 was used to correct for expected cell frequencies smaller than 5.

* $p < .05$, ** $p < .01$

Second, differences in *medications orders* (presence/absence) were evaluated with respect to the identified responses categories. Specifically, contingency tables were created for orders of Aspirin, anti-nausea medications (i.e., Zofran and Phenergan), infrequently ordered medications (i.e., Nitroglycerin, Morphine, and the ‘GI cocktail’¹⁰⁰) and, more generally, whether or not participants ordered medication independent of the type of medication. The results of the analyses are summarized in Table 22 excluding the category reflecting infrequent medication orders due to lack of significant findings. As can be seen, 15 out of 16 or 93.7% of the participants who used contextual clues (e.g., ‘The patient was brought in by a concerned wife’; ‘Men normally don’t come in for mere suspicion’) ordered at least one type of medication compared to only 12 out of 23 or 52.1% of those who did not (Yates’ $\chi^2(1) = 5.83, p = .016$). More specifically, participants who used contextual clues ordered significantly more often aspirin ($\chi^2(1) = 3.95, p = .047$) and anti-nausea medication ($\chi^2(1) = 4.45, p = .035$) than those participants who did not consider these contextual clues. In particular, 10 out of 16 participants (62.5%) who used contextual clues ordered aspirin compared to 7 out of 23 participants (30.4%) who did not use this information. Similarly, 13 out of 16 participants (81.2%) who used contextual clues ordered anti-nausea medication whereas a comparable order was made by only 11 out of 23 participants (47.8%) of those who did not mention contextual clues in their responses. A similar effect could be observed with respect to whether or not participants’ responses reflected a ‘cautious’ attitude and the ordering of anti-nausea medications (Yates’ $\chi^2(1)^1 = 3.99, p = .046$). Specifically, whereas 10 out of 11 or 90.9% of the participants who explicitly stated their ‘cautious’ attitude ordered anti-nausea medications for the patient, only 50% of the participants without a ‘cautious’ attitude made similar orders.

Table 22

Contingency Tables between Response Categories Medication Orders

<i>Response Category</i>	<i>Medication Orders</i>					
	Aspirin (ASA)		Anti-nausea medication		Medication orders	
	Absent	Present	Absent	Present	Absent	Present
Stoic character clue						
Contextual clues	$\chi^2(1) = 3.95, p = .047^*$		$\chi^2(1) = 4.45, p = .035^*$		$\chi^2(1)^1 = 5.83, p = .016^*$	
Absent	16	7	12	11	11	12
Present	6	10	3	13	1	15
Demographic clues						
Appearance clue						
Cautious attitude	$\chi^2(1)^1 = 3.99, p = .046^*$					
Absent			14	14		
Present			1	10		
Rapport intentions						

Note: ¹Yates' χ^2 was used to correct for expected cell frequencies smaller than 5.

* $p < .05$, ** $p < .01$

Finally, the relationships between *test/study orders* and the identified response categories were statistically investigated. Specifically, contingency tables were created for 4 compound classes of test/study orders such as orders related to ‘monitoring’¹⁰¹ and ‘sustaining’¹⁰², the patient’s state of health, orders related to ruling out cardiac etiologies (i.e., the cardiac panel¹⁰³) as well as infrequently ordered tests¹⁰⁴. In addition, 11 single test orders were evaluated with respect to the identified response categories (e.g., orders of a chest x-ray, liver profile, or a urinalysis; for a complete list of all test orders investigated see Appendix V.4). Table 23 summarizes the pattern of results for three basic, cardiac related tests orders, the Basic Metabolic Panel (BMP), the Complete Blood Count (CBC), as well as the Cardiac Panel (CP).

Table 23

Contingency Tables between Response Categories and Test Orders

<i>Response Category</i>	<i>Test/Study Orders</i>					
	BMP ¹⁰⁵		CBC ¹⁰⁶		CP ¹⁰⁷ (ordered as set AND in separate orders)	
	Absent	Present	Absent	Present	Absent	Present
Stoic character clue	$\chi^2(1)^1 = 10.93, p = .001^{**}$		$\chi^2(1)^1 = 6.07, p = .014^*$		$\chi^2(1)^1 = 3.01, p = .031^*$	
Absent	7	3	7	3	10	0
Present	3	26	6	23	19	10
Contextual clues	$\chi^2(1)^1 = 3.20, p = .074$					
Absent	3	20				
Present	7	9				
Demographic clues						
Appearance clue	$\chi^2(1)^1 = 2.03, p = .154$					
Absent	1	12				
Present	9	17				
Cautious attitude					$\chi^2(1) = 2.20, p = .138$	
Absent					15	13
Present					3	8
Rapport intentions						

Note: ¹Yates' χ^2 was used to correct for expected cell frequencies smaller than 5.

$p < .05$, $^{**} p < .01$

As can be seen, the presence or absence of all 3 of these test/study orders is related to the category denoting whether or not participants considered the patient's stoic character when reasoning about the described patient. Specifically, with respect to the BMP (Yates' $\chi^2(1) = 10.93, p = .001$), the proportion of participants who ordered this test was almost three times as large for participants who reasoned about the patient's stoic behavior (26 out of 29 or 89.6%) compared to those who did not (3 out of 10 or 30%). Similarly, the proportion of participants who ordered the CBC was more than double for participants who considered the patient's stoic character (23 out of 29 or 79.3%) compared to those who did not (3 out of 10 or 30%).

The last class of test/study orders displayed in Table 23 is a compound order denoting whether or not participants ordered the Cardiac Panel (CP) as a single order (i.e., the panel) *as well as* by ordering all single orders included in this panel (i.e., a portable chest x-ray, BMP, CBC, and EKG). With respect to this compound order (Yates' $\chi^2(1) = 3.01, p = .031$), 10 out of 29 or 34.5% of the participants who considered the patient's stoic behavior ordered both the CP panel *and* all individual tests. A similar pattern of test orders could *not* be found for participants who did not reason about the patient's stoic character. Additional and marginally significant relationships (contingencies) between the identified responses categories and particular test orders can be found in Appendix V.6.

VII. SURVEY STUDY DISCUSSION

The first goal of this study was to experimentally disentangle the effect of different ecological clue categories on ED physicians' reasoning and decision making. Specifically, experimental manipulations were devised to understand how ED physicians' reasoning and decision patterns change as a function of perceived patient characteristics. In the chosen vignette, the patient's central characteristic was a stoic, non-complaining character. This characteristic had implications for how the patient's 'mild chest tightness' had to be interpreted in order to evaluate for and identify the patient's acute cardiac condition. Thus, to assess how participants' responses changed as a function of perceived patient characteristics, a patient descriptor was systematically manipulated (i.e., the patient was introduced as 'a stoic, blue collar worker'; 'an apprehensive, white collar worker'; or without a specific descriptor) while keeping all other parts of the vignette constant (e.g., the patient's complaints and the physicians' interview questions). Based on an evaluation of the manipulation check and participants' open-ended responses, it was shown that there was no differential effect of patient descriptor changes on participants' perception of the patient depicted in the vignette. In other words, the patient was *not* perceived differentially across experimental conditions (i.e., the applied manipulations were ineffective). Thus, the described results *cannot* be used to address the first goal of this study which was to test the hypothesis that, with respect to the chosen vignette, differentially perceived patient characteristics would impact participants' reasoning processes and decision making.

However, participants did differ - independent of experimental condition - with respect to the implications they associated with the patient's stoic character as portrayed in

the vignette. Specifically, whereas the majority of participants characterized the patient in terms of his tendency to conceal actual complaint(s), 10 out of 39 participants used generic terms to describe the patient without mentioning functional implications of the patient's reduced ability to relay medical information. Conceptually identical to the effect intended with the applied manipulations, these differences in participants' understanding of the patient's character and respective differences in their concern for potentially concealed diseases can be used to understand ED physicians reasoning and decision patterns. In addition, the use of four unique clue categories (i.e., medical, non-medical, epidemiological, and organizational clues) and two different classes of intentions/attitudes (i.e., a 'cautious' attitude and intentions to engage in rapport-inducing behavior) were identified in participants' responses. Although the identified response categories did *not* allow hypothesis testing, they provided a basis for *describing* and *exploring* how the use of certain clues (e.g., the patient's stoic character) and/or differences in certain attitudes and intentions relate to participants' reasoning processes and decision making. More generally, they provided a basis for addressing the *second* and *third goal* of this study by *cross-validating* and *extending* the observational findings with the results of this survey study. Before discussing the results of this study in light of the observational findings, there are several findings that help clarify the conceptual nature of the identified response categories.

Discussion of the Identified Response Categories

Participants' perception of the patient's stoic character

With respect to the validity of the identified clue categories, all of the 4 major clue categories in participants' responses (i.e., medical, non-medical, epidemiological, organizational clues) were found in the observational data. Moreover, there were several

findings in participants' importance ratings of different aspects of the physician-patient relationship that helped explain and clarify some of the coded qualitative differences in participants' responses (i.e., the response categories). First, participants who explicitly recognized the functional implications of the patient's stoic character rated information about patients' physical symptoms as well as patients' ability to articulate complaints as more important than those participants who did not refer to the patient as a stoic patient or 'minimizer.' This suggests that for participants who recognized that the patient was not talking and/or complaining much, the patient's impaired ability to articulate complaints during the physician-patient encounter may have been a more salient factor. Similarly, due to the lack of a detailed experiential account of the patient's complaint(s), physical symptoms (and particularly seemingly benign symptoms such as "a little" chest tightness) may become a relatively more important source of information in the clinical reasoning and decision making process. This suggests that the response category denoting whether or not participants considered the patient's stoic character reflects differences in participants' perceptions with respect to functional implications of a stoic patient for care delivery.

Organizational clues/constraints

With respect to participants' use of organizational clues/constraints, a statistical or quantitative description was not possible due to lack of variability (only 4 participants referred to this information in their responses). However, with respect to the purpose of cross-validating the observational results, the main finding is that few participants in this survey study used and considered organizational clues/constraints although they were neither asked to do so nor were these clues immediately necessary to solve the task they were given. Specifically, participants' task was to devise an initial evaluation plan for the

described patient, not to justify a particular disposition. Thus, participants' statements (e.g., 'A family history of cardiac history helps to make the case if the patient is to be admitted'; 'Does the patient have a [primary care physician] who can follow-up after discharge?'; 'Admission depends on what is subsequently ordered and who follows [patient] up in the ED') suggest that organizational clues/constraints may be relevant not only for disposition decisions but dynamically connected to ED physicians' evaluation strategies. The fact that ED physicians used organizational clues/constraints not only in a naturalistic setting but also when given a paper-and-pencil task with a conceptual focus on evaluation decisions provides support for similar findings in the observational data.

Attitudes/Intentions

With respect to the validity of the attitudes/intentions coded in participants' responses, two patterns were identified in terms of their relationship with the dependent measures. First, participants with responses that were coded as reflecting a 'cautious' attitude scored significantly higher on the mindfulness/mindlessness scale (MMS) than those participants without such responses. Given that the MMS is intended to measure more stable tendencies to be mindful (i.e., the MMS is a trait versus state measure; Bodner & Langer, 2001), this suggests that participants who explicitly expressed their level of suspicion are generally more mindful than those who did not. This finding provides confirming evidence that the coded responses are reflective of participants' tendency to remain mindful or cautious with respect to their task (e.g., providing emergency care) and/or the patient (e.g., the discrepancy between the patient's purported complaints versus actual state of health). Apart from being more mindful, the same participants also scored higher on the revised, short version of the Health Care Climate Questionnaire (HCCQ)

indicating that participants who stated their ‘cautious’ attitude also are more patient-centered.

The second pattern is related to the category denoting whether or not participants stated intentions to engage in rapport-inducing behavior. Although this category was expected to correlate with a patient-centered attitude, it did not show any relationship with the HCCQ. However, participants who stated intentions to engage in rapport-inducing behavior and did *not* recognized the patient’s stoic character considered the patient’s social background and personality as less important than those participants who either recognized the patient’s stoic disposition or did not state rapport-related intentions. This suggests that intentions to engage in rapport-inducing behaviors may be used as a generic method to help any patient, independently of personality and social background, feel more comfortable and share information. That is, rapport-inducing behavior may be a particular method to bridge social and inter-individual differences and create a better communication environment.

With respect to the potential impact of ‘mindfulness’ and ‘rapport’ on clinical reasoning and decision making, this suggests that these factors may describe two different, though related, strategies in ED physicians’ toolbox to effectively cope with the social dynamics pertaining to patient-physician encounters in the ED. Specifically, whereas participants’ statements about rapport-inducing behavior seem to be related to the acquisition of better quality information, findings related to mindfulness suggest that a mindful/cautious attitude is mainly used to recognize the potential and often novel implications of certain types of information for effectively solving the task at hand. As has been suggested based on the observational data, this suggests that ED physicians will not be able to functionally apply rapport-inducing behaviors if they are not also mindful about

a patient's need for rapport. Conversely, if a mindful/ cautious attitude is not coupled with a genuine and trusting relationship, 'mindfulness' may potentially result in perceptions of mutual distrust between the physician and the patient (by definition the opposite of rapport).

Response Categories and Two Patterns of Findings

One pattern of findings is related to participants' tendency to constrain the range of possible dispositions (i.e., the solution space) for the described patient (i.e., full admission versus admission for observation). Results from the observational study indicate that constraining the space of likely/possible solutions to the patient's problem in turn guides and constrains (confines) what kind of evaluation processes are or have to be considered by the physician. The present findings can be used to elaborate on this contention and provide a quantitative description of the underlying processes. The second pattern is related to participants' focus on differential diagnoses based on the patient's complaints (i.e., the potential problem space). Results from the observational study indicate that the ruling out of possible diagnoses is based on how ED physicians constrain the number of potential problems/concerns to be considered for the evaluation of a particular patient (e.g., the differential diagnosis may focus on 'worst cases' or 'common things'). The following paragraphs will describe the quantitative findings that seem to describe similar patterns in the experimental data.

Patterns related to patient disposition

Based on the analyses, two patterns were identified with respect to participants' judgment of how likely the described patient required full admission or admission for observation. Specifically, participants whose responses did not reflect a 'cautious' attitude

were found to judge admission for observation more likely than full admission. The same pattern was found for participants who stated a ‘cautious’ attitude but did *not* consider the patient’s stoic character. Interestingly, the reverse pattern could be identified for participants who considered the patient’s stoic character *and* provided responses reflecting a ‘cautious’ attitude. That is, these participants judged full admission of the patient more likely than admission for observation.

Admission for observation can be considered a precautionary measure to rule out *potential* problems that could not be ruled out in the ED. On the other hand, patients require full admission for treatment of certain critical conditions that have been *identified* in the ED and require immediate medical attention. This suggests that the group judging admission for observation as more likely than full admission was not sure or less able to gauge how serious the patient’s condition was. That is, for this group of participants the patient’s condition, although serious enough to likely warrant admission for 23 hours of observation, was not clearly defined and/or did not appear severe enough to justify full admission. On the other hand, participants with a ‘cautious’ attitude and an awareness that the patient was ‘minimizing’ his complaints were more certain that the patient would require full admission for his condition instead of only admission for observation. In other words, based on a ‘cautious’ attitude and information about the patient’s stoic character, these participants may have been better able to define and/or anticipate the likely severity of the patient’s state of health. In turn, this led them to be more certain as to what the patient’s disposition was going to be. That is, they were able to constrain the range of possible dispositions (i.e., solution space) to be considered during evaluation of the patient.

Patterns related to patient evaluation

The identified disposition patterns are complemented by findings pertaining to the number of medical concerns stated in participants' responses. The number of concerns stated reflects participants' abilities to more or less clearly anticipate and delimit the patient's likely medical problems (i.e., the problem space)¹⁰⁸. From a conceptual perspective, this measure can be related to the disposition patterns identified in participants' probability judgments. Whereas admission for observation reflects uncertainty with respect to the severity of the patient's medical problems, more concerns indicate less certainty about the patient's potential medical problems. Conversely, whereas full admission reflects more certainty about the severity of the patient's state of health, fewer concerns indicate more certainty about the patient's potential problems.

With respect to the identified response categories, more medical concerns were stated by participants who used demographic information such as sex, age, and the patient's lack of previous medical history but did not consider the patient's stoic character. On the other hand, all participants who considered contextual clues (e.g., 'the patient was brought in by a concerned wife'), the patient's stoic character, and/or stated intentions to engage in rapport-inducing behavior mentioned fewer concerns in their responses than those who did not. More specifically, those participants who stated intentions to engage in rapport-inducing behavior were less likely to mention infrequent concerns in their responses than those who did not. That is, they considered common medical threats rather than more esoteric diseases in their differential diagnoses.

With respect to the response categories that are related to the number of medical concerns, there is a difference between epidemiological clues on one hand and non-medical clues as well as rapport-related intentions on the other. That is, epidemiological clues are generic in nature whereas non-medical clues and rapport-related intentions are situation-specific. As such, demographic information may have helped participants devise differential diagnoses based on the patients' complaints (i.e., the range of possible medical problems) but it may not have allowed participants to delimit this range of medical problems based on the patient's specific circumstances. This contention can be supported based on a similar finding that has been observed in the ED. Specifically, due to lack of more detailed information about a patient with multiple complaints (including chest pain), the attending physician in Case 4 stated: *'She is 47 years old, she is a woman, not hypertensive but tachy. She has a better chance of being discharged if we do it all [i.e., rule out all concerns].'* Thus, the patient's sex, age and vital signs (a medical clue) suggested to the attending physician that no concern can be ruled out a priori and it is the safest decision to 'do it all.' That is, to be able to discharge the patient, all medical concerns had to be ruled out in the ED. This example provides support for the explanation that participants who used generic demographic information stated relatively more concerns in their responses because no concern could be ruled out a priori.

On the other hand, participants who also reasoned about non-medical clues such as the patient's stoic character were able to reduce the number of concerns in their differential diagnosis. All non-medical clues identified in participants' responses were situation-specific in that they described the patient's particular circumstances. Thus, they may have helped participants constrain the number of medical concerns to be considered for the case

at hand (i.e., the problem space). The ‘worst case’ for the patient described in the vignette was related to a potential cardiac event. As stated above, participants who recognized the patient’s stoic character (a non-medical clue) considered physical symptoms as relatively more important and therefore may have been more concerned about the patient’s ‘mild chest tightness.’ A similar explanation may pertain to participants who reasoned about the patient’s concerned wife. Using mild chest pain as a relatively more reliable indicator for cardiac etiologies, these participants may have focused on (ruling out) the main ‘worst case’ while putting less emphasis and/or neglecting other, less likely etiologies.

Another potential explanation for differences in the number of medical concerns is based on the finding that participants who stated intentions to engage in rapport-inducing behavior also mentioned fewer concerns in their responses than those who did not. Specifically, these participants had realized that the patient was not providing adequate amounts and/or quality of information. So they were intending to and maybe more confident they would be able to obtain more/better information from the patient by increasing physician-patient rapport. Thus, they may have stated fewer concerns to avoid prematurely identifying differential diagnoses before ruling major threats (i.e., worst cases) and obtaining more detailed information from the patient¹⁰⁹.

Summary of the identified patterns

Similar to the general findings in the observational data, some participants in the experiment seemed to have been able to approach the patient’s complaints by constraining the problem space (the possible medical problems to be considered during evaluation) and/or the solution space (the possible/likely disposition of the patient). By doing so, they could delimit the problem to be solved (i.e., the concerns to be ruled out in the ED). The

ability to narrow down and more precisely define the problem at hand was related in systematic ways to the kinds of clues participants used as well as their attitudes and intentions. Specifically, participants who used non-medical clues (i.e., contextual clues as well as information about the patient's stoic character), stated intentions to engage in rapport-inducing behavior, or exhibited a 'cautious' attitude were able to reduce the number of concerns they were considering. Similarly, participants who considered the patient's stoic character (a non-medical clue) and deliberately maintained a 'cautious' attitude were able to increase the certainty with which they considered a certain disposition (i.e., full admission). In the next section, I will discuss the relationship between participants' differential ability to constrain the problem to be solved (i.e., the two patterns in participants' evaluation and disposition strategies) and the actual outcome as well as clinical knowledge measures obtained for this study.

Evaluation/Disposition Patterns and Evaluation/Treatment Decisions

Decision processes: The number of clues used

With respect to the number of clues used, two types of effects were identified. First, among participants who did not consider the patient's stoic character, those with responses reflecting a 'cautious' attitude used significantly more clues than those participants without a 'cautious' attitude. On the other hand, participants who considered the patient's stoic character used similar amounts of clues regardless of a 'cautious' attitude. This indicates that awareness of the patient's stoic character may have increased attention to more information (details).

The second finding is related to the fact that there was a significant negative correlation between the number of clues identified in participants' responses and the

number of medical concerns. Participants who used few clues overall may have stated many different medical concerns because the information provided by these clues did not provide a rationale for ruling out diseases and delimiting the space of possible medical problems (e.g., generic demographic information such as sex, age, or the patient's lack of previous medical history). However, participants' who used contextual information as a clue expressed fewer concerns (a constrained problem space) yet used more clues in general.

From a practical perspective, participants who considered non-medical clues did so in addition to medical information, which all participants considered equally. This finding is paradoxical, however, with respect to the tenet of ecological rationality, which states that fast and frugal decisions are based on only few clues and simple decision steps (i.e., simple information search, stopping and decision rules; see Gigerenzer et al., 1999). This apparent contradiction between theory and the present findings can be resolved by considering that participants used more (non-medical) information not to make a decision but to constrain, in an abductive leap, both the problem space (the number of potential concerns to be ruled out) and the solution space (the patient's likely disposition). As shown by the observational data, by matching constraints in problem and solution spaces, the problem to be solved can be simplified so that few clues and pieces of information remain necessary to make effective decisions. For example, ED physicians 'listen to the patient' and create rapport to obtain more/better medical information and also to learn more about non-medical clues that describe patients' particular needs, concerns, and personal circumstances. During observations such information was used to constrain or define the problem space (e.g., in Excerpt 12 the physicians stated: *'I saw I would need to sit with this woman ... just to let*

her vent if nothing else and to affirm the legitimacy of her concerns. In ... spending way more time than normal for such a complaint I was able to come up with a wholly different theory of why he was having these problems’; in Case 26 the physicians stated: ‘*She is basically depressed and needs somebody to talk to... she wants to stay ... so my work-up is going to focus on finding a reason to admit her*’) as well as the solution space (e.g., in Case 25 the attending physician lowered the admission threshold because the patient lived far away from the ED and could not easily come back).

Decision outcomes: Test and medication orders

There were two measures of decision outcomes: medication and test orders. With respect to *medication orders*, participants who used contextual clues *and* considered the patient’s stoic character ordered more medications than those who considered only one or none of these two clue categories. Participants who used contextual clues were more likely to order any kind of medication including Aspirin and anti-nausea medicine. Similarly, participants who provided responses reflecting a ‘cautious’ attitude were more likely to order anti-nausea medications compared to those who did not.

Contextual clues, information about the patient’s stoic character and a ‘cautious’ attitude may have helped participants to reduce the level of uncertainty with respect to the potential medical problems underlying the patient’s complaint (e.g., by being relatively more concerned about a particular issue). Thus, one way to look at this finding is that more medication orders may be related to the fact that these participants were more ‘cautious’ or simply knew more clearly what they were concerned about. First, although pain management is a standard procedure/service for all ED patients, these participants may have been more likely to engage in pain management because of contextual considerations

such as the fact that the patient was brought in by a *concerned* wife (the order of anti-nausea medication). Second, they may have been more likely to administer Aspirin because they assumed the patient was likely suffering from a cardiac incident (e.g., one contextual clue was: ‘Early morning is MI time’; one ‘cautious’ statement was: ‘Listen well to not misinterpret gastroenteritis and miss subtle chest pain’).

With respect to *test/study orders*, participants explicitly stating a ‘cautious’ attitude or intentions to engage in rapport-inducing behavior ordered more tests than those who did not state such intentions or attitudes. On the other hand, participants who used demographic information ordered fewer tests than those who did not. The first finding suggests that a ‘cautious’ attitude may have led participants to connect the patient’s indifferent expression of the problem (e.g., ‘a little tight maybe’) with a potential ‘worst case.’ Therefore, these participants may have ordered more tests/studies to obtain specific information that would potentially clarify the nature of the patient’s complaints. Similarly, participants with intentions to engage in rapport-inducing behavior identified the lack of adequate information about the patients’ complaints (e.g., chest tightness). Because these participants realized that the described patient was not readily sharing information about his complaints, they may have ordered more tests to compensate with information from the laboratory and be able to make more informed decisions when evaluating the patient a second time after the initial evaluation. On the other hand, demographic clues (e.g., sex, age, lack of previous history) may have made it difficult to constrain the range of possible concerns and resulted in a few basic orders to help narrow down the differential diagnoses. A similar strategy was evident from the observations. For example, in Case 23, after ordering basic labs for a patient with blood in the urine (i.e., Complete Blood Count (CBC),

Basic Metabolic Panel (BMP)), the attending ED physician suggested: '*He has no pain though. We hold off ... he has no history of [kidney] stones, right? ... We can always scan him later.*' That is, because the patient's problem was unclear at the time and the patient did not have a previous history of kidney stones (coded as a demographic/epidemiological clue in this study) the physician in Case 23 ordered a few basic labs to be able to make a more informed decision at a later time.

In addition to differences in the number of tests/studies ordered, three specific test/study order effects were identified for participants who considered the patient's stoic character versus those who did not. In particular, participants who considered the patient's stoic character were more likely to order *both* the cardiac *panel* (an aggregate order comprised of four separate test orders) and all four *individual tests* that are comprised in this panel. That is, these participants ordered at an aggregate level (the panel) and made additional orders at the more specific level of individual tests. Given the fact that participants who recognized the patient as a 'minimizer' rated physical symptoms as relatively more important compared to those who did not, this apparent inefficiency allows interesting speculations about the effect of patient characteristics (i.e., the patient's stoic character) on ED physicians' decision making.

One possible explanation for the identified effects is that participants who referred to the patient as stoic may have been relatively more concerned about pathologies related to benign physical symptoms such as the patient's chest tightness (i.e., potential cardiac problems). Consequently, they may have attempted to counterbalance the ambiguity inherent in the patient's purportedly benign presentation by bringing into awareness and ultimately ordering tests that are specifically tailored to ruling out the main concern for this

patient (i.e., cardiac etiologies). In other words, instead of relying on standard orders at the aggregate level (i.e., the cardiac panel), they went beyond standard procedures and specified their workup with tests that would effectively rule out heart disease. That is, if a patient is potentially sicker than he is willing to admit, patient characteristics may help ED physicians to adjust their level of concern (e.g., the patient may require full admission), which may help them bring to mind and ultimately order tests/studies that explicitly address and rule out these concerns.

It is interesting in this regard that those participants who explicitly recognized the patient's stoic character, also ranked significantly higher on the administered mindfulness/mindlessness scale (MMS). The MMS scale is designed to measure peoples' ability to see a common problem (e.g., a complaint of nausea and vomiting with mild chest tightness) with new eyes (e.g., is it possible that a seemingly benign complaint points to other, initially non-intuitive and more covert diseases processes). Although a 'cautious' attitude forms a central part of ED physicians' accepted method (i.e., 'worst case' thinking), this finding suggests that ED physicians may possess a differential propensity to be 'mindful' and consequently different degrees of sensitivity to the implications of patient characteristics (or other medical and non-medical clue categories) for clinical reasoning and decision making. This contention has potential implications for training and selection of ED resident physicians and should be explored further in future research.

Evaluation/Disposition patterns and Clinical Knowledge/Experience

With respect to clinical knowledge (participants' score on the in-training knowledge exam), several interactions between the identified response categories could be identified. Specifically, high performers on the exam tended to use contextual clues, state a 'cautious'

attitude, and intentions to engage in rapport-inducing behavior. Low performers, on the other hand, tended to consider the patient's physical appearance (an epidemiological clue) and information about the patient's stoic character. In addition, there was a significant positive correlation between participants' tenure as ED residents and their performance on the knowledge exam. That is, higher performance on the exam was associated with longer tenure (i.e., more clinical experience) as a resident ED physician.

One interesting finding is that the high performing group did *not* use relatively obvious information such as information about the patient's stoic character (the vignette was designed around a stoic patient) or the patient's physical appearance, which was explicitly stated in the vignette ('Edsel didn't look so good'). Instead, they used contextual clues, which were experience-based (e.g., 'AM is common MI time,' 'Men don't come in for mere suspicion') or had to be inferred from what was said in the vignette. For example, several participants mentioned the clue that the patient was brought in by his *concerned* wife although the vignette simply mentioned that 'his wife brought him in because he just didn't feel right.' In other words, high performers relied on previous experience or less obvious, more subtle information (the patient's concerned wife) as well as a 'cautious' attitude and rapport-related intentions. One explanation may be that these participants considered the patient's physical appearance and stoic character not as a clinically relevant clue. This explanation seems unlikely given that several incidences could be observed where ED physicians used the patient's appearance and information about a 'minimizing patient' to adjust evaluation strategies. Alternatively, they may have avoided this information because they thought it was misleading or because other, more informative (contextual) clues were available. Unfortunately, data from this study does not provide

conclusive evidence to support any particular explanation. Future research will have to investigate whether these findings were incidental or whether the tendency to rely on subtle contextual clues is strategic and functionally related to performance outcomes for more complex medical cases.

In addition, several relationships between participants' clinical knowledge score and the evaluation and disposition patterns discussed above may be identified. First, participants who exhibited a 'cautious' attitude but did not consider the patient's stoic character judged it more likely that the patient will be admitted for observation than require full admission. Thus, participants with higher scores (and relatively more clinical experience) tended to be less committed to a particular disposition of the patient. Although they judged it likely that the described patient required admission for observation high performers did not seem to have identified a specific reason to justify full admission early during the evaluation process.

Second, participants who used contextual clues stated fewer concerns and used more clues. In addition, fewer concerns were counted for participants with intentions to engage in rapport-inducing behavior. The use of more clues was related to participants who stated a 'cautious' attitude but did *not* consider the patient's stoic behavior. Third, participants who used contextual clues were more likely to order Aspirin and anti-nausea medication (as did participants with a 'cautious' attitude). Finally, participants with intentions to engage in rapport-inducing behavior or with a 'cautious' attitude ordered more tests/studies. This suggests that participants with higher scores on the exam tended to state fewer concerns, use more clues, and were more likely to order Aspirin, anti-nausea medicine, and more tests/studies. On the other hand, participants, who scored lower on the

exam than the highest performing group, used information about the patient's stoic behavior or physical appearance. Those participants who used information about the patient's stoic character stated fewer concerns than those who did not, judged admission for observation more likely than full admission, and were more likely to order both the cardiac panel as well as all individual test included in this panel. These relationships allow the following conjectures.

First, apart from the types of clues participants used, the main difference between high and low performers is that participants who considered the patient's stoic character (participants with relatively lower scores) compared to those who did not (participants with relatively higher scores) ordered the cardiac panel at the aggregate *and* individual test level. Given that exam performance and resident status was significantly and positively correlated, this difference may have been due to an increased concern but also less clinical experience and therefore less knowledge of the different tests included in the cardiac panel. This is a likely explanation of the observed effects given that the contents of this panel are particular to a specific ED¹¹⁰ and the order sheet used for this study was taken from this ED. Further evidence for this contention comes from the fact that a (marginally) greater proportion of third-year residents (with longer tenure in the residency program and more clinical experience) could be found in the group of participants who did not explicitly recognize the patient's stoic character. This increases the relative proportion of participants with shorter tenure in the group that considered the patient's stoic character and ordered both individual and panel orders.

Second, apart from this difference, both high and low performing groups tended to constrain the problem space (i.e., the number of concerns) and both groups judged

admission for observation more likely than full admission. Even a third group of participants that considered contextual information, exhibited a ‘cautious’ attitude, *and* reasoned about the patient’s stoic character was able to reduce the number of concerns to be considered and ordered more medications. The only difference between this third group and the high and low performing group was that the third group judged full admission more likely than admission for observation. This difference may be due to the fact that the ‘minimizing patient’ is a familiar term for a particular type of ED patient and therefore may increase the certainty with which ED physicians approach such patients and their problems. However, the converging findings seem to point to a more fundamental problem/limitation of the present study in that participants who used specific types of clues and/or exhibited different attitudes and intentions could not be clearly differentiated with respect to performance outcomes (e.g., the number of concerns considered, the kind of disposition anticipated, or the main concern for a cardiac ‘worst case’). This contention will be further elaborated in the limitation section.

Summary of Statistical Findings

There are two consistent patterns in the data. The first pattern is related to participants’ use of epidemiological clues. Participants who used demographic information stated more concerns and ordered fewer tests/studies. Participants who considered the patient’s physical appearance scored relatively lower on the in-training exam than those who did not use this information as well as those who used contextual clues. Given the positive correlation between performance score and tenure as ED resident, this may indicate that only relatively less experienced participants used this clue. Examples from the observational data were used to provide an explanation for this pattern of findings.

Specifically, the observed ED physicians used demographic information to devise differential diagnoses whereas they used the patient's physical appearance to adjust the perceived severity of a patient's complaints. However, because this information is nonspecific with respect to a patient's particular circumstances, it does not help ED physicians constrain the range of potential problems. Thus, if no other information is available, epidemiological clues may provide a default evaluation strategy to rule out all potential medical problems (i.e., to 'do it all').

Interestingly, survey study participants who used epidemiological clues tended to return their filled-out surveys early whereas participants who used non-medical clues tended to rank among the participants who returned their filled-out survey later. This suggests that the processing of situation-specific, non-medical clues takes more time or effort. Thus, the use of epidemiological clues may not only provide a default strategy if more specific information is not available but to 'do it all' also seems to provide a means to shortcut more elaborate reasoning about the specifics of a particular case. In other words, epidemiological information may be leveraged for fast and frugal decision making under time pressure. Given that participants took a 4-hour, multiple-choice exam immediately prior to participating in this study, it is a likely explanation for the present findings that participants resorted to a fast and frugal, 'do-it-all' evaluation strategy that would help to finish early.

The second pattern is related to participants' use of non-medical clues (i.e., contextual clues and information about the patient's stoic character) as well as to their 'cautious' attitudes (a manifestation of mindfulness) and rapport-related intentions. These participants tended to state fewer concerns, used more clues, and ordered more (specific)

tests/studies and medications. This pattern of findings may be due to the fact that these clues, attitudes, and intentions help ED physicians increase their understanding of the patient's problem. Consequently, more targeted tests and medications can be ordered. It is interesting in this respect that these types of clues (except the patient's stoic character) were used by participants who scored higher on an exam that was designed to measure clinical knowledge. Given that these participants were likely also more experienced (had longer tenure as ED residents), this finding suggests that, with experience, contextual information (if available), a 'cautious' attitude, and rapport-related intentions are used to complement, if not enhance good clinical knowledge. This finding supports observational evidence that ED physicians make extensive use of non-medical information in actual clinical situations.

Although the present findings provide converging evidence for some of the observational data, the ineffectiveness of the experimental manipulations and the generally exploratory nature of the performed analyses raise methodological concerns about the validity of the obtained findings. Moreover, all participants, independent of their reasoning strategy and/or the clues they were considering, came to essentially the same conclusion with respect to the evaluation of the patient depicted in the vignette. That is, independently of which combination of clues they considered, all participants were concerned (although possibly to a different degree) that the patient portrayed in the vignette was potentially suffering from a cardiac emergency (i.e., a 'worst case'), which led them to initiate (more or less specific) evaluation strategies to rule out and successfully identify cardiac problems. This is an important finding of the present study speaking to the general effectiveness of 'worst case' thinking for the practice of emergency medicine. However, it also suggests

that awareness of the patient's stoic character as well as other non-medical information may not have been necessary for effectively solving the problem depicted in the vignette. This provides another explanation for why some participants resorted to the use of generic demographic information although more specific data was available. In sum, given these limitations of the performed study, potential alternative explanations for the obtained data must be explored.

Limitations, Alternative Explanations, and Future Research

Limitations

One major limitation of the present study is the ineffectiveness of the manipulations and therefore *exploratory nature of the analyses* coupled with a relatively low number of participants – that is, *lack of statistical power*. In other words, the above findings provide initial support for the observational findings but it will be necessary to replicate these exploratory results in another study using a larger sample and a more effective manipulation. In addition, the sample of participants was limited to first, second, and third-year ED resident physicians. Future research should investigate whether a wider range of participants in terms of clinical experience results in different findings and/or changes the interpretation of the data (e.g., an attending physician with 30 years of clinical experience may reason differently, make different decisions and/or be attuned to different types of clues compared to an attending physician who just finished residency).

On conceptual grounds, one critique of the present study is reflected in a statement made by one of the participants after filling out the order sheet: “*As lab/studies results come in, I'd narrow my [differential diagnosis] and add other labs/studies as indicated. In the end, I feel confident I'd get this guy taken care of.*” This statement suggests that

emergency care delivery is fundamentally a *continuous* and *dynamic process* rather than a one-time decision/judgment as was required for this experiment. The dynamics between disposition, evaluation, and treatment decisions that are characteristic of the actual clinical setting, let alone the unfolding social dynamics referred to in the observational study, cannot be effectively captured using the present ‘paper-and-pencil’ study design. This suggests that a longitudinal design, a simulated setting, and/or critical incidence interviews (Flanagan, 1954) may be more appropriate methods to capture and disentangle the effect of perceived patient characteristics on the dynamics underlying clinical reasoning and decision making.

To circumvent some limitations of paper-and-pencil studies, the present research used two methods to cross-validate survey data with observational findings and vice versa. Although findings are exploratory in nature, methodological triangulation and converging evidence from two very different methods increases confidence that the presented results are not spurious. Given that the applied manipulations were ineffective, further experimental evidence is required to provide more conclusive evidence in support of the present findings.

Finally, the fact that all participants, independently of which types of clues they used, focused their evaluation on potential cardiac problems may be explained by a statement made by one of the participants. To explain why the physician in the vignette was able to identify the patient’s heart condition, participant number 21 stated: ‘*All pointed to chest, no good reasoning for vomiting, minimizing symptoms.*’ In other words, one reason for the lack of variation in participants’ evaluation strategies (all evaluated for a cardiac ‘worst case’) may be that a single vignette with *a common medical complaint* (i.e.,

nausea and vomiting with mild chest tightness) was used to test the effect of interest. That is, the ‘worst case’ implications of the chosen complaint and appropriate evaluation procedures in the ED (i.e., ruling out cardiac causes for any patient with chest pain) may have been particularly obvious because the vignette was designed and defined with respect to this particular ‘worst case’ outcome. Moreover, given the experimental nature of the study setting, participants may have been able to anticipate that the described patient was suffering from a medical ‘worst case’ without considering the specifics of the vignette. That is, it would be rather unlikely that a study involving emergency medical reasoning does not revolve around a medical ‘worst case’ (although ‘worst cases’ were rather the exception and not as common in the observed clinical settings). In other words, a vignette depicting a more ambiguous medical complaint may have resulted in a more clearly differentiated pattern of responses. This contention will be elaborated in the next section based on a discussion of alternative explanations for the observed effects.

Alternative explanations

A strength but also potential limitation of this study is related to the circumstances under which the experiment was administered. Participants had worked for at least 4 hours on a comprehensive 200-item in-service examination¹¹ before receiving the experimental material. Thus, it is likely that participants were tired and lacked motivation to deliberate and provide elaborate explanations and rationales for their reasoning. Instead, participants were likely trying to achieve good enough results with moderate effort. There are two possible (likely overlapping) pathways to save effort with respect to the present study. First, participants may have been applying heuristic shortcuts to effectively circumvent more elaborate ‘text-book’ procedures (e.g., epidemiological data may have been used to

perform a ‘do-it-all’ strategy). Thus, the chosen research procedure was particularly suited to address the second and third goal of this study (i.e., to cross-validate and extend the observational findings in a more controlled setting and with a slightly larger sample of ED resident physicians). On the other hand, it is equally likely that in trying to reduce effort, participants *also* did not fully explain what they actually thought and did. More relevant from a conceptual perspective, the former possibility will be further explored.

The assumption underlying this study was that the described patient’s stoic character was an important factor in adequately interpreting this patient’s complaints and gauge their actual severity. One important finding of this study is that a statistically significant majority of participants used the patient’s stoic character when reasoning about the patient’s complaints. In other words, the majority of participants interpreted the patient’s complaints in light of his stoic demeanor, which suggested that the patient’s complaint (i.e., he felt ‘a little uncomfortable’ and maybe ‘a little tight’ in the chest) pointed to a potentially worse disease (e.g., a heart attack) than the patient was willing to admit (i.e., ‘I just think I have a bug or something’). Consequently, their workup focused on ruling out the potential cardiac ‘worst case.’ However, the identified response categories have shown that patient characteristics were not the only type of information pointing to the fact that the patient portrayed in the vignette may potentially suffer from a medical emergency. Specifically, from an epidemiological perspective, any chest pain patient is at risk for cardiac problems if he is male, 48 years old, has no previous history of cardiac check-ups and ‘doesn’t look so good.’ Similarly, ‘other’ non-medical (i.e., contextual) clues such as a concerned wife and the time of day pointed to a potentially severe medical problem. In other words, the patient’s stoic character was not the only clue, and therefore

sufficient but *not* necessary information, to suspect a ‘worst case’ despite the patient’s seemingly ‘benign’ complaints. The multiple determinacy of the *actual* severity of the patient’s complaint described in the vignette has implications for both the interpretation of the results of this study as well as avenues for future research.

Implications for data interpretation. Support for the contention that awareness of the patient’s stoic character was sufficient but not necessary for addressing the patient’s complaint can be derived from two main findings. First, it was stated above that the use of epidemiological information may be used as a fast and frugal ‘do-it-all’ strategy to circumvent more elaborate processing of specific information about a particular patient. Interestingly, the use of the patient’s physical appearance (an epidemiological clue) was related to lower performance on the clinical knowledge exam, which, in turn, was correlated to less clinical experience. Second, there was a (marginally) significant relationship between participants’ tenure in the residency program and their use of patient characteristics in clinical reasoning. Specifically, among the 10 participants who did not mention patient characteristics in their responses, there were 6 third, 2 second, and 2 first-year residents. More experienced (i.e., third year) residents may have recognized that the use of patient characteristics (i.e., the patient’s stoic demeanor) was not necessary to adequately solve the problem presented in the vignette. In addition, 6 out of 10 participants who did not mention patient characteristics in their responses were among the first ten participants who returned the filled out questionnaire. Thus, it is possible that these participants may have been able to reduce effort and time to complete the experiment by neglecting information about the patient’s character. Similarly, 3 of the remaining 4 participants in this group were among the last 8 who returned their questionnaire

suggesting that these participants may have ignored information about the patient's stoic character because they were looking for ways to reduce effort because they were tired.

This suggests that there were at least three strategies that were used to effectively solve the problem described in the vignette. The first strategy is associated with participants who considered the patient's stoic character and exhibited a 'cautious' attitude. This group of participants used many clues, focused on few concerns, and was most certain that the patient's complaint was serious and required full admission. The second strategy is reflected in a fast and frugal 'do-it-all' strategy based on epidemiological information. This strategy is associated with many concerns, few test and medication orders, and participants' tendency to return filled-out surveys early. Finally, the third strategy ignored the patient's stoic character but was based on the use of contextual information as well as a cautious attitude and rapport-inducing behavior. This strategy was preferably used by high performing participants who used many clues, focused on few concerns, and suspected that the patient required admission for observation.

On the other hand, participants in the group that did not mention patient characteristics in their responses tended to rank lower on the mindfulness/mindlessness scale. This suggests that this group generally tends to be less sensitive to novel distinctions in their environment (cf. Bodner & Langer, 2001; Langer, 1989). In other words, there may be an attitudinal/dispositional factor involved in whether or not participants used patient characteristics (e.g., a patient's stoic character) when reasoning about a medical complaint. Future research will have to address whether the observed differences in ED physician's use of patient characteristics reflect the selection of particular types of fast and frugal strategies and/or an attitudinal/dispositional factor that is modifiable with training and can

be used to categorize ED physicians with respect to their reasoning patterns. To do so, it will be necessary to use a set of vignettes that better delineate and differentiate the functional implications of specific clue categories (e.g., medical, epidemiological, patient characteristics, and ‘other’ non-medical clues) with respect to their implications for the clinical reasoning process. This leads to the discussion of potential avenues for future research (i.e., the second implication of a multiply determined medical problem) in terms of a more effective choice of medical problems and clue categories.

Implications for future research. As stated above, the vignette selected for this study depicted a common complaint (i.e., nausea and vomiting with mild chest tightness) and provided clues from multiple categories that suggested a more severe complaint than the portrayed patient was willing to admit. Given that different types of clues resulted in similar interpretations of an every-day complaint (although potentially via different pathways), ultimately, all participants ordered tests to rule out cardiac etiologies with respect to the patient’s complaint of chest tightness. This finding clearly demonstrates the effectiveness of ‘worst case’ thinking for the practice of emergency medicine. However, the fact that the potential complaint of the patient described in the vignette was multiply determined by different types of clues (i.e., over-specified) may have concealed and/or eliminated important differences in reasoning between participants who considered certain clues compared to participants who did not. In addition to having more clearly distinguishable and clinically relevant manipulations of patient characteristics, this implies two possible pathways for future research. First, vignettes with more ambiguous types of medical problems (see Appendix VI.1 for an example of a patient with altered mental status) may help increase the relative salience of medical, epidemiological, and non-

medical clues in ED physicians' reasoning and decision processes. Second, the simultaneous use of clue categories that point to differing levels of disease severity (e.g., a benign versus lethal disease process) would require participants to be more selective when choosing their strategies and more careful to identify information that would lead to an adequate interpretation of medical complaints and ultimately, delivery of safe medical care.

For example, in the vignette used for this study patient characteristics as well as epidemiological and non-medical clues pointed to a worst case. Future research could investigate whether changing clue categories in the same vignette –while maintaining all features of the medical complaint – can be used to increase the relative importance and use of patient characteristics in clinical reasoning. Specifically, epidemiological clues could be chosen to point to a more benign problem such as pregnancy (e.g., depicting a nauseous/vomiting patient who is female and 30 instead of 48 years old). Similarly, non-medical clues could be chosen to point to a non-emergent problem (e.g., the patient may have been dropped off, not brought in, by the spouse and “look fine” instead of “not so good”). Participants who recognize patient characteristics (e.g., a minimizing patient) and incorporate this information in their clinical reasoning may then be more likely to interpret the mild chest tightness as relatively more important than those who do not recognize patient characteristics and/or receive a vignette describing a very different patient type (e.g., a complaining patient). This study/vignette design may provide a way to demonstrate the impact of certain clue categories (e.g., patient characteristic) on effective clinical reasoning more clearly than the design used for the present study. The same conceptual approach of using more ambiguous complaints and/or combinations of clue categories may be used to test the impact of clues other than patient characteristics (e.g., medical,

epidemiological, or specific sets of other contextual clues). In general, to test the differential impact of different types of clues on ED physicians' ability to detect 'worst cases,' all clue categories may be chosen to suggest benign medical problem and left identical across conditions while the medical implications of the specific clue category of interest is systematically varied. By doing so, this design may be able to underline the functional importance of particular types of information for ED physicians' reasoning as well as the benefits associated with an increased sensitivity to such information for identifying 'worst cases' in an effective manner.

Summary of the Survey Study

The experimental part of this research has shown that – despite ineffective manipulations and the fact that cardiac etiologies were multiply determined – the clue categories ED physicians used as well as their intentions and attitudes had a differential impact on their reasoning and decision patterns. Although the presented findings are tentative, it can be concluded that, if available, certain clues (i.e., the patient's stoic character, contextual clues), intentions (rapport) and attitudes (suspicion) may help ED physicians effectively gauge the relative importance of clinical symptoms and, more generally, interpret medical information with respect to the patient's particular circumstances. In turn, this may help to adjust and specify evaluation procedures and ultimately, identify medical 'worst cases.'

Conceptually, cognitive scientists have shown that bounds on cognitive resources force people to resort to heuristic processing and selective attention to only a *few* clues to solve a given problem (e.g., Gigerenzer et al., 1999; Kahneman, Slovic, & Tversky, 1982). However, the present findings suggest that some participants used *more* clues to constrain

the problem at hand. Although these findings seem to be at odds, they are only apparently so. Based on predefined laboratory tasks and decision problems, cognitive scientists have shown that, depending on the fit between a chosen heuristic and the structure of the environment, reliance on few pieces of information results either in characteristic biases and errors (e.g., Kahneman, Slovic, & Tversky, 1982; Lichtenstein, Fischhoff, & Phillips, 1982; Tversky & Kahneman, 1973) or effective decision mechanisms (e.g., Gigerenzer et al., 1999). However, cognitive scientists have hitherto largely neglected how those few clues (as well as the decision mechanism operating on these clues) are selected if problems are *not* a given. The present study suggest that participants who used more clues were able to delimit the problem to be solved and more clearly define the options to be considered (e.g., medical concerns to be ruled out) in the subsequent decision making process (e.g., resulting in more targeted medications/tests orders). That is, participants may have used more clues not to make a decision but to modify the decision problem so that more targeted (evaluation) decisions could be made (see next section¹¹²). In sum, based on the results of this study, it can be said that problem identification is an important part of the decision making process in ill-structured domains without pre-defined problems (cf. Reitman, 1964; Voss & Post, 1991; in the medical field see Shalin & Bertram, 1996). The present research provides preliminary empirical evidence for possible mechanisms underlying problem identification in an every-day emergency medical task.

From a methodological perspective, although the specification of complaints via multiple types of clues may closely reflect a naturalistic setting, it decreased the probability to detect and isolate changes with respect to a single clue category (e.g., the patient's stoic character). Future research will be necessary to further disentangle the effect of specific

types of clues by selecting different (e.g., more ambiguous) medical problems and stronger manipulations of the clue category of interest (e.g., patient characteristics). On the other hand, the present study provided converging evidence with respect to the observational data. Findings from both the survey and observational study will be summarized and discussed in the next and final section.

VIII. GENERAL DISCUSSION AND SUMMARY

One main finding based on the observational data is that ED physicians' fundamental task is *not* to diagnose specific medical problems. Instead, their main concern is to accurately *disposition* patients. That is, their focal task is to identify whether patients are 'sick' and require immediate treatment and admission to the hospital or are 'not sick' and can be discharged with follow-up care on an outpatient basis. In other words, ED physicians' core task is to ascertain the nature of a medical complaint, its acuity and severity and, based on this classification, to decide whether and where in the health care system the patient can receive the necessary care. The observational data as well as the survey study showed that ED physicians' strategies to achieve this task are essentially situated in a particular medical, social, organizational, and more generally, sociocultural context. Nonetheless, this research provided a formal description of two general heuristic strategies in ED physicians' adaptive toolbox as well as strategies ED physicians used to adapt these strategies to the demands at hand. First, a summary of the 'general' heuristics will be provided. The following sections will focus on how ED physicians situate these heuristics in a particular context.

General Heuristics

The 'worst case' heuristic

The importance and effectiveness of the 'worst case' heuristic for the practice of emergency medicine was apparent in both observational and experimental results. Specifically, independent of the clue category participants used in the survey study, all participants focused their evaluation on cardiac 'worst cases' and would have identified the

patient's heart condition. More generally, the assumption underlying this heuristic is that patients, based on their set of symptoms, may suffer from a list of lethal diseases (i.e., medical 'worst cases') that need to be ruled out. By relying on the 'worst case' search rule ED physicians do not need to identify a precise medical diagnosis. Instead, potential 'worst cases' act as a safe (i.e., 'good enough') working hypothesis, which helps to constrain the number of medical concerns to be evaluated (i.e., the problem space). The *inductive logic* underlying the process of ruling out possible 'worst cases' is grounded in and ecologically rational with respect to a strong legal environment (cf. Bitterman, 2001) and prevailing sociocultural values in the U.S. such as an emphasis on specialized, high-tech treatment of esoteric diseases compared to the delivery of population-wide primary care (Shi & Singh, 2008). In this sense, the 'worst case' heuristic on one hand and the constraints of the ED domain on the other are two blades of a scissors (Simon, 1990), which cuts through the complexity and ambiguity inherent in the practice of emergency medicine in the U.S. by providing a safe and workable guide to action. The 'worst case' heuristics, as a systematic method to identify 'sick' patients and save their lives, is a safe and *formally accepted method* for emergency medicine professionals in the U.S.

Observations also lead to the identification of a major drawback of the 'worst case' heuristic. Specifically, in its unabated form, this heuristic trades off safe with efficient medical care in that it emphasizes catching the *rare* 'worst case' versus identifying the most *likely* disease (e.g., 'He admits everybody and puts them through the scanner ... He will encounter reality at one point. You cannot keep doing this all the time'). That is, in its extreme form, this strategy results in preventative admissions and defensive medicine, increases numbers of false positives, and ultimately results in inefficient allocation of

scarce medical resources. This is a particularly relevant problem given steadily increasing patient volumes in U.S. EDs (NCHS, 2007) and growing numbers of non-paying, uninsured ED patients (IOM, 2006). To reduce the number of false positives, a less sensitive strategy is necessary, which filters out unimportant, noisy information and tends to focus on what is common and to be expected instead of what is unlikely but undesirable. The next paragraph will describe the second general heuristic that could be identified in the data – that is, a second tool in ED physicians’ adaptive tool box – to account for the limitations of the unabated ‘worst case’ heuristic.

The ‘common-things-are-common’ heuristic

Another general heuristic identified during observations is the ‘common-things-are-common’ heuristic. Whereas the ‘worst case’ heuristic focused on ruling out (often unlikely) lethal diseases underlying patients’ symptoms, this heuristic assumes that patients suffer from diseases that are *commonly* associated with their set of symptoms. For example, in the survey study, all clues provided in the vignette pointed to the ‘worst case’ of a cardiac event making this cardiac condition a common/likely problem. In this case, the ‘common-things-are-common’ heuristic is identical with the ‘worst case’ heuristic. On the other hand, it differs from the ‘worst case’ heuristic if symptoms do not explicitly point to a ‘worst case’ but to a common, benign disease. Then, ED physicians’ evaluation strategies may not need to search for the unlikely ‘worst case’ but can rely on lesser procedures that focus on identifying patients’ most likely medical problems¹¹³. The process of testing initial hypotheses about patients’ *likely* medical problem is grounded in ED physicians’ knowledge of common symptom- disease relationships. It is ecologically rational with

respect to pervasive resource constraints in the ED, for example, time pressure (Croskerry, 2002) and increasing patient volumes (IOM, 2006).

Conceptually, the ‘common-things-are-common’ heuristic complements the ‘worst case’ heuristic. That is, the former heuristic effectively filters out ‘noisy’ and ‘misleading’ information and more conservatively focuses on ‘common’ symptom -> disease relationships, which help to increase care delivery effectiveness. Specifically, a focus on likely medical problems helps ED physicians adapt evaluation strategies for patients who seem ‘not sick’ and therefore require lesser procedures. The ‘common-things-are-common’ heuristic modifies the problems to be considered (i.e., the problem space) and effectively modulates the sensitivity of consecutive evaluation procedures based on patients’ most probable states of health (‘sick’ versus ‘not sick’). However, the ‘common-things-are-common’ heuristic will *fail* – compared to the ‘worst case’ heuristic – in the rare case when an uncommon ‘worst case’ presents in the disguise of commonly benign symptoms. That is, the ‘common-things-are-common’ heuristic is more efficient but less safe than the ‘worst case’ heuristic.

General heuristics: Summary

In summary, two *general* heuristics in ED physicians’ adaptive toolbox were identified. Both heuristics are *fast and frugal* in that they provide ED physicians with ways to constrain the range of problems to be considered for evaluation. By doing so, they help define the boundaries of the problem to be solved. In other words, the general heuristics in ED physicians’ adaptive toolbox are abductive mechanisms which help in “forming an explanatory hypothesis” (Peirce, 1931/1994, p. 117) of the possible causes of a (medical) problem and consequently, for ways how this particular problem might be solved.

Specifically, these heuristics focus *information search* processes either on ‘worst cases’ or likely diseases associated with a particular set of symptoms. They provide simple *stopping rules* that justify termination of the care delivery process after having ruled out ‘worst cases’ or identified ‘common’ diseases. Finally, these general heuristics suggest simple *decision rules*. If ‘worst cases’ could be identified, the patient will be treated appropriately and admitted; if ‘worst cases’ could be ruled out, the patient will be discharged with follow up; if in doubt, the patient is likely to be admitted, at least for 23 hours of observation. For the ‘common-things-are-common’ heuristic, if a ‘common’ disease could be identified, the patient will be discharged with follow up; in the unlikely case that a ‘common’ disease could not be identified, it may be necessary to apply the ‘worst case’ algorithm to follow up on the patient’s more unlikely but life-threatening medical problems.

Safety-efficiency tradeoff. As a general heuristic, the ‘common-things-are-common’ is *more efficient* than the ‘worst case’ heuristic because it reduces the proportion of false positives by correctly identifying patients who are ‘not sick’ (more correct rejections) and therefore do not require elaborate evaluations for ‘worst cases.’ On the other hand, the ‘common-things-are-common’ heuristic is *more risky* because it is less sensitive to minor changes and deviations in patient’s complaints/symptoms. This increases the chances of missing unlikely ‘worst cases’ in patients who are actually ‘sick’ but present with symptoms that are commonly associated with benign medical problems. An ‘ideal’ or perfectly rational ED physician would be able to optimize the tradeoff between the risks of missing a ‘worst case’ and the costs of extensive testing and preventative admissions. Observations indicated that there may be inter-individual differences in that some physicians tend to strictly adhere to the ‘worst case’ heuristic (e.g., Excerpt 5) whereas

others exhibit a more risky but also more efficient care delivery style (e.g., Case 9).

Second, the observed ED physicians as well as the participants in the survey study tended to opportunistically exploit the availability of contextual information and constraints to modify explanatory hypotheses about the patient's medical problems (i.e., the problem space), adjust care delivery goals and disposition strategies (i.e., the solution space) and ultimately, *satisfice* the requirements for a stable and effectively functioning ED system. In other words, bound by both their cognitive resources as well as the characteristic constraints of the ED environment, ED physicians behave in ecologically rational ways. Findings pertaining to the types of constraints/information ED physicians used to (re)structure the problem space and solution space (i.e., to identify the problem to be solved) and to situate the selection of the described general heuristics (i.e., to select the appropriate care delivery strategy) will be discussed in turn.

Constraints Used to Structure the Problem Space

As stated above, the accepted method (i.e., default strategy) ED physicians use to evaluate and disposition their patient is the 'worst case' heuristic. The problem space corresponding to this strategy is built around potential 'worst cases' that are associated with a patient's set of symptoms and complaints. The observational results as well as the survey study described certain types of information (i.e., clue categories) ED physicians used to situationally ground and modify this 'worst case' problem space. As a result, ED physicians were able to constrain the number of medical concerns to be evaluated (i.e., restructure the problem space associated with a patient's set of complaints) and, consequently, order more targeted tests/studies and/or medications. The discussion of how

ED physicians restructured the problem space will be limited to those main constraints/clue categories that could be identified in both observational and survey study.

Previous medical history (PMH)

To constrain the problem space, the observed ED physicians considered their patients' PMH. For example, in Case 30 the Resident thought 'it's not a stroke' due to a benign physical exam and because the patient's and paramedics' stories do not coincide. However, the attending physician suggested to 'work [the patient] up as a stroke' because 'if she had a [transient ischemic attack] before, she needs evaluation and be admitted.' Conversely, in Case 32, the same attending physician suggested to '*do a rule out*' with outpatient follow up for an 82 year old patient who had no prior history of heart disease, a negative first set of cardiac enzymes and 'good-looking' chest x-ray. That is, observed ED physicians used patients' PMH to gauge which heuristic strategy, the 'worst case' or the 'common-things-are-common' heuristic, was most adequate.

Also participants in the survey study used the patient's PMH. Specifically, they reasoned about a lack of PMH with cardiac problems and related to check-ups (this information was subsumed with other demographic clues such as sex and age). Participants who used demographic information stated more medical concerns and ordered fewer tests/studies than participants who were aware of additional information (e.g., the patient's stoic character). That is, participants who used this type of clue were not able to rule out and/or constrain the number of medical concerns for a middle-aged, male patient. Instead, these participants considered many potential 'worst cases' including cardiac etiologies given the lack of a PMH such as a cardiac check-up or stress test. Similar evidence was described in Case 4 with respect to a patient with multiple complaints including chest pain

and tachycardia. In this case, the attending physician concluded that *'She is 47 years old, she is a woman, not hypertensive but tachy[cardic]. She has a better chance of being discharged if we do it all.'* Finally, given a wide range of differential diagnoses, it was economic for participants in the survey study to order a few tests that would help narrow down the number of concerns before ordering more targeted tests later on. For example, Case 32 has shown that a few basic tests such as a chest x-ray or cardiac enzymes can moderate ED physicians' concerns for a patient with intermittent chest pain but no cardiac-related PMH (*'Do a rule out and send him home'*). In other words, research findings provide evidence that if sex, age, and PMH point to a list of potential 'worst cases' and no other information is available (or considered), the range of potential concerns is wide and ED physicians have *'do it all.'* To not waste resources, however, they may order a few tests to narrow down the differential diagnoses and potentially order more targeted tests at a later time.

Patient's personality and personal circumstances

Observations have shown that the ED domain is ill-structured not only from a medical perspective but is marked by social dynamics between physician and patient/family that incur an additional level of complexity and ambiguity. Moreover, findings suggested that ED physicians with good people skills can create physician-patient rapport (cf. DiMatteo, 1979), obtain better information from a trusting patient, and ultimately, communicate effectively with the patient about medical complaints, the patient's needs and preferences, and adequate solutions strategies. The result of this process is mutual understanding of the situation (i.e., common ground) between physician and patient (e.g., Clark & Schaefer, 1989). Examples have shown that ED physicians who established

common ground made situated guesses about their patients' likely medical problems (i.e., the problem space). Moreover, they identified targeted strategies to address both the patient's medical and personal needs with the resources (i.e., the solution space) available in the ED. For example, the physician in Case 26 evaluated the patient 'to find a reason to admit her' because she was depressed and needed 'someone to talk to.' Conversely, the resident physician in Case 28 provided medical standard care for an elderly patient with broken ribs. This physician did *not* manage, however, to establish common ground with the patient's family who was ultimately '*irate*' because their needs and preferences for a solution to the patient's mobility problems (i.e., the actual problem) were not addressed.

Unfortunately, observational techniques did not allow a systematic investigation of how ED physicians' understanding of their patients' needs and concerns impacts care delivery. Thus, to extend the observational findings, one focus of the survey study was to investigate how the perception of a particular patient personality (i.e., a stoic character) as well as the patient's particular circumstances (e.g., the patient was brought in by a concerned wife) impacts ED physicians' reasoning and decision making. The survey study revealed that ED physicians who considered the patient's stoic character as well as contextual clues about the patient's personal circumstances were able to constrain the number of medical concerns considered for evaluation. Moreover, participants who reasoned about the patient's stoic nature ordered tests related to ruling out cardiac etiologies at a more detailed level and those who used contextual information were more likely to order anti-nausea medications and Aspirin, which is usually administered to prevent heart attacks. Similarly, participants who stated intentions to engage in rapport-

inducing behavior to obtain more (personal) information from the patient stated fewer medical concerns in their responses and ordered more tests/studies.

In other words, participants who considered information about the patient's personality and personal circumstances or the patient's need for rapport-inducing behavior were able to delimit the range of their concerns (i.e., the problem space). Although, on one hand, they considered fewer concerns, they were more alarmed about a potential cardiac problem than other participants, which led them to order appropriate tests and/or medications. Thus, these findings provide support for the observational finding that ED physicians' understanding of their patients' personality and specific circumstances is instrumental in delimiting the range of a patient's potential medical problems (i.e., the problem space) as well as in implementing targeted evaluation and treatment strategies.

In summary, this research provided converging evidence for two broad categories of constraints (i.e., PMH and demographic information as well as information describing the patient's personality and personal circumstances) ED physicians used to (re)structure the problem space relevant for the evaluation of a particular patient. More specifically, in an abductive leap, they used this information to devise hypotheses about a patient's most likely medical problems. In turn, these hypotheses helped ED physicians to situationally adapt their general heuristics to focus on particular medical concerns and decide how sensitive their evaluation strategy should be to ascertain the patient's problem.

Constraints Used to Structure the Solution Space

If the uncertainty inherent in a patient's complaints cannot be reduced with evaluations in the ED, one solution may be to admit the patient. For example, in Case 18 the physician states that with *'more questions than answers ... We will admit him and look*

into things further.' In this case, the ED physician was able to shortcut evaluation in the ED (increase efficiency) because there was the option to delegate the responsibility for more in-depth evaluation (the patient's medical safety) to a specialist in the hospital. This example shows that the choice of a particular strategy to identify a patient's disposition is dependent upon and cannot be completely understood without considering the options that are available to disposition the patient (i.e., the solution space).

Based on observational findings several constraints ED physicians used to delimit and (re)structure the solution space were identified. These were in the form of options available for dispositioning a particular patient: constraints introduced by the health care system, the ED/hospital organization, the physician's experience, and the patient. Only few findings pertaining to constraints on solutions could be identified in the survey study. This is not surprising for several reasons. First, the survey study was designed to study initial evaluation and test order decisions. Second, constraints on action introduced by the health care system and the ED/hospital organization were not explicitly manipulated or introduced in a way that would impact evaluation decisions in a meaningful way. Third, compared to more experienced attending physicians, the participants (resident ED physicians) had relatively little clinical experience. Thus, it is less likely that a population of resident physicians has already accumulated many experiences with constraints on and implications of disposition decisions. In the survey study, only two participants mentioned prior experience with a case such as the one described in the vignette. Nonetheless, several conclusions can be drawn by comparing the results of the observational and survey study, particularly with constraints on the solution space introduced by the patient.

Constraints introduced by the ED/hospital organization

To constrain the solution space, observed ED physicians used *constraints inherent in the ED/hospital organization*. For instance, once an ED physician decided to admit a patient s/he needs to be able to justify this decision when talking to the admitting physician. Although the resident physician in Case 24 was able to provide ‘seven reasons to admit’ a patient, the attending physician wanted the Resident to order additional tests to be able to prevent time-intensive discussions with an admitting physician about whether or not the patient actually required admission. Although the survey study yielded only sparse data in this regard, few study participants reasoned about organizational constraints. Most notably with respect to Case 24, when asked what additional information would be of help, one participant stated that ‘Family history helps make [the] case if admission is needed.’ In other words, based on previous experience and with the intention to save time (increase efficiency), both physicians planned to obtain additional information (i.e., test results or family history) because the potential need to provide these tests was implied in the intended solution to the patient’s problem (i.e., easy admission to the hospital). Despite scarce evidence based on the survey study, the fact that participants reasoned about organizational constraints not only in the observed naturalistic setting but also when given a paper-and-pencil task and without being asked to do so provides confirming evidence that ED physicians consider organizational constraints on the disposition decision. More controlled experimental research will be necessary to further investigate how ED physicians use these types of constraints to constrain the range of potential dispositions and disentangle how the so constrained solution space impacts reasoning and decision making.

Constraints introduced by the patient's personality and personal circumstances

Another set of constraints ED physicians used to delimit the solution space pertained to their patients' personalities, personal circumstances as well as their needs and preferences. For instance, Case 25 showed how an ED physician adjusted the admission threshold and evaluation strategies for a patient who lived far away from the ED and therefore could not easily come back in case of a worsening problem ('I will make sure he is fine if he is going home'). Case 28 provided an example of how the patient's needs ('[the patient] is basically depressed and needs someone to talk to... she wants to [be admitted]') were used by an attending physician to focus the 'work-up ... on finding a reason to admit [the patient].'

In a similar vein, the survey study showed that ED physicians who recognized that the patient was stoic and not sharing information perceived the patient's medical problem and his likely disposition differently. Specifically, results indicated that participants who were aware of the patient's stoic character *and* 'cautious' about missing potentially relevant information (e.g., 'patient is stoic = extremely important to ... get a good history') judged full admission more likely than admission for 23 hours of observation. Moreover, participants with a 'cautious' attitude ordered more tests/studies and participants who reasoned about the patient's stoic character were more specific when ordering tests related to ruling out cardiac etiologies (i.e., they ordered the cardiac panel *as well as* all individual tests included in this panel). In other words, participants with a 'cautious' attitude who considered the patient's stoic character were able to delimit the solution space. That is, they were more certain that the patient required full admission for a 'worst case' versus admission for observations to rule out a potential medical problem. To identify the suspect

‘worst case,’ they ordered more tests and focused test orders on ruling out cardiac etiologies. Thus, findings from both studies provide evidence that awareness of a patient’s personality (e.g., the downplaying of complaints), personal circumstances, or needs helps ED physicians’ delimit a patient’s likely disposition and ultimately, the choice of a targeted evaluation strategy.

In summary, evidence from both observations and the survey study suggested that ED physicians identify the problem to be solved in the ED by exploiting constraints on the range of potential solutions to a patient’s problems. Several strategies ED physicians used to restructure the solution space could be identified and differentiated with respect to the constraints on action they exploit. For example, to constrain the range of possible solutions, there is converging evidence from both studies that ED physicians took advantage of constraints that are associated with the setup of the ED/hospital organization as well as the personal circumstances of the patient. ED physicians exploited potential implications of these constraints to adjust the nature (i.e., the types of tests) and sensitivity of the evaluation procedures initiated in the ED.

On a general level, in situations where a certain disposition decision offers a low degree of safety for the patient (e.g., a stoic patient who minimizes complaints may be discharged although suffering from a ‘worst case’¹¹⁴), ED physicians may compensate by increasing the sensitivity of the evaluation in the ED. Conversely, in situations with a high degree of safety where the patient’s problem can be best addressed by referring the patient to a specialist (e.g., ‘Everybody with some skin thing goes to the derm clinic, that's our service for skin patients’) ED physicians may limit care delivery to stabilizing treatments while shortcutting more in-depth evaluation. In other words, ED physicians may exploit the

‘degree of safety’ inherent in a disposition decision by compensating for a lack of safety with more thorough evaluation in the ED. On the other hand, they may benefit from a disposition that offers a high a degree of safety by delegating more thorough evaluation to another (specialized) care provider and increasing efficiency of evaluation in the ED.

On the downside, observational evidence showed that by exploiting constraints on the solution space to provide the patient with an appropriate level of medical safety, efficiency gains in the ED are traded off with increasing workload for other care providers in the health care system. Conversely, if no care provider is available to follow up on a patient, all responsibility falls on the ED physician to provide the patient with adequate and safe medical care¹¹⁵. From a conceptual perspective, this finding speaks to the essential interconnectedness between decision making at the individual level and constraints on action set at different levels of social complexity (e.g., the level of the health care system, the organizational system of the ED and/or hospital as well as the individual level comprised by patients and physicians themselves). The fact that ED physicians exploit and, at the same time, create constraints on action that pertain to individual, organizational, and societal levels of a work system provides empirical support for other multi-level conceptualizations of situated cognition such as the one suggested by Lave (1987).

Conceptual Summary and Implications

The premise of this dissertation was the humans are bound both by cognitive capacity limitations as well as environmental possibilities (Simon, 1955, 1956). The goal of this research was to explore and better understand bounded rationality of ED physicians in their natural environment, the emergency department. At the outset of this dissertation, three perspectives on bounded rationality were mentioned (cf. Gigerenzer & Selten, 2001).

First, bounded rationality has been framed as ‘*optimization under constraints*,’ which contends that people search for decision-relevant information until costs associated with further search start to exceed the benefits of obtaining additional information (e.g., Stigler, 1961). Second, the *bias and heuristics approach* emphasizes cognitive bounds on human rationality (Simon, 1955), which constrain peoples’ ability to optimize decision processes (e.g., Kahneman, 2003). This perspective on bounded rationality has shown that peoples’ cognitive limitations force them to deviate from *normative* models of rationality and resort to heuristic decision making, which may “lead to severe and systematic errors,” biases, and fallacies (e.g., Tversky & Kahneman, 1974, p. 1124). Finally, the third perspective on bounded rationality - *ecological rationality* - is based on Herbert Simon’s notion of the mind and the environment as two blades of a pair of scissors – the structure of the environment on one hand and the structure of the mind on the other (Simon, 1990). If the two blades of this scissors fit, then cutting will be easier. That is, if the structures in the mind (e.g., associations, heuristics, or expectations) are in good correspondence with constraints in the environment, then these constraints can be leveraged to improve the efficiency of information or computational processes. This research suggests that these approaches do not necessarily represent contradictory positions but describe the same phenomenon from useful, though different, perspectives. Thus, the conceptual challenge emerging from the results of this research is to find a way to reconcile these three approaches.

Ecological rationality and the present research

The main tenet of the concept of ecological rationality is that, by exploiting functionally salient information structures (i.e., constraints) in the environment, people are

able to make ‘good enough’ decisions with computationally manageable strategies (i.e., heuristics). The present study has identified two general heuristics in ED physicians’ adaptive toolbox. These heuristics provided means to delimit the range of patients’ possible medical problems based on salient information (i.e., ‘worst cases’ or ‘common things’) and identify adequate solution strategies. This finding adds to scarce empirical evidence suggesting that fast and frugal heuristics (as hitherto defined) cannot only be identified in constrained laboratory tasks and do not only ‘work’ in abstract computer simulations but that human decision makers (i.e., ED physicians) use a fast and frugal heuristic in a complex, naturalistic decision environment.

As with every heuristic, these strategies are situation-specific and, if applied out of context, result in characteristic biases as reflected in a tendency to emphasize safe or efficient emergency care. Hitherto, decision making research has provided only scarce evidence as to how people “determine which type of environment they are in, and then which heuristics will be appropriate to apply” (Todd & Gigerenzer, 2007, p. 169). The present findings demonstrate that there is no predefined environment to be determined by ED physicians. Rather, this research suggests “firstly, that the final solution is mediated by successive reformulations of the problem [to be solved], and secondly, that these reformulations or solution-phases are in their turn mediated by general heuristic methods¹¹⁶” (Duncker, 1945, p.47). In the terms used to describe the findings of this study, ED physicians used a set of abductive strategies that exploited constraints on medical problems and on possible problem solutions to actively (re)formulate the problem and solution spaces and, ultimately, delimit the problem to be solved. By grounding the problem to be solved in a particular environment and situational constraints, ED physicians

were able to delimit the range of applicable evaluation strategies (i.e., general heuristics in their adaptive tool box) and select those that, with respect to the particular environment/situation, were most likely to result in safe and efficient care delivery. The results of the chosen evaluation procedures were used to iteratively refine the structure of the problem and solution spaces. In short, ecologically rational decision making in the ED is based on an abductive and dynamic process of hypothesis generation and testing.

In summary, the present study yielded evidence of the use of ecologically rational heuristics in a naturalistic setting. Moreover, it yielded findings with respect to how ED physicians decide which heuristic to apply when. Conceptually, this research suggests that to understand the selection of ecologically rational heuristics it is necessary to appreciate how ecological constraints on both problems as well as actions/solutions shape problem identification (cf. Duncker, 1945). This provides empirical support for the “claim that much problem solving effort is directed at structuring problems, and only a fraction of it is solving problems once they are structured” (Simon, 1973, p. 187). However, problem identification has hitherto received only scarce attention by main stream research into human problem-solving and decision making (cf. Reitman, 1964; Shalin & Bertram, 1996; Voss & Post, 1988).

Optimization under constraints and the present research

ED physicians decided the tradeoff between safe versus efficient evaluation strategies without engaging in exhaustive and logical consistent deliberations such as the calculation of an *optimal* stopping rule (cf. Anderson & Milson, 1989; Sargent, 1993; Stigler, 1961). That is, they did not ‘optimize under constraints.’ Instead, by opportunistically exploiting constraints on medical problems and solutions strategies, ED

physicians were able to select those evaluation strategies that, with respect to the particular environment/situation, were most likely to result in safe and efficient care delivery. That is, they were ‘satisficing under constraints.’

This can be stated more formally by relating ED physicians’ use of constraints to Rasmussen’s (1986) knowledge-, rule-, and skill-based cognitive processes. From this perspective, ED physicians’ decision making does not involve exhaustive, normative computation or high-level, knowledge-based processes. Rather, observational evidence suggests that ED physicians traded off safe versus efficient care decisions with low computational effort by resorting to lower-level, rule-based associations between ecological constraints and their implications for the most appropriate evaluation strategy. In other words, the (re)structuring of problem and solution spaces allowed the selection of heuristic short cuts that approximate more normative computational processes in terms of accuracy but without incurring similar cognitive demands. It is in this sense that ED physicians’ selection and use of the general heuristics is ecologically rational.

Conceptually, ‘optimization under constraints’ assumes performance maximization under constraints (i.e., the optimal stopping rule) and has therefore been criticized as an unrealistic model of human decision making and bounded rationality. Based on the present research, this concept can be reframed as a psychological plausible and efficient mechanism - ‘satisficing under constraints’ - when it is considered that tradeoffs are not only decided in the ‘mind’ via effortful computational processes. Instead, agents may resolve tradeoffs by exploiting experience with a domain-specific set of constraints on problems and solutions to identify situationally adequate decision strategies that yield satisfactory results.

Biases and heuristics and the present research

The two identified, general heuristics in ED physicians' adaptive toolbox represent two complementary strategies with respect to medical safety and evaluation efficiency. As general heuristics, the 'worst case' heuristic emphasizes safe care and results in many false positives whereas the 'common-things-are-common' heuristic emphasizes efficient care and increases the number of missed 'worst cases.' Thus, if applied out of context, these heuristics result in characteristic biases towards safe or efficient care delivery. However, based on the present findings, ED physicians' use of general heuristics is essentially situated in a web of ecologically meaningful constraints on what is to be done and on what can be done. That is, unlike in laboratory experiments used to study biases and heuristics, the selection and use of heuristics in a naturalistic environment is always based on an ecologically meaningful rationale. This does not imply that ED physicians are immune to decision making biases. Indeed, some physicians may be generally more cautious and 'admit everybody and put them through the [CAT] scanner' whereas others think that 'you cannot keep doing this all the time' because it is an inefficient strategy and similar results can be obtained with less aggressive evaluation procedures (see Excerpt 5). However, the fact that the selection of heuristics is grounded in ecologically meaningful constraints on a particular care situation suggests that ED physicians' performance is likely to be satisfactory with respect to this situation, most of the time.

Conceptually, this entails that to understand and explain reasoning in a lived-in setting such as the ED and to differentiate heuristic biases from ecologically rational heuristics it is necessary to identify the ecological constraints on problems and actions that shape and are shaped by heuristic reasoning. This finding has implications for current

cognitive science approaches to studying medical reasoning and expertise but also decision making in general. First, cognitive theory and research on medical expertise has hitherto focused almost exclusively on describing and modeling the development and use of knowledge structures physicians ‘carry’ in their minds (for summaries see Evans & Patel, 1992 and Schmidt, Norman, & Boshuizen, 1990). The present research provided further empirical evidence that to understand and explain peoples’ reasoning processes and behavioral tendencies it must be considered that these processes have developed as an adaption to functional relationships (e.g., Brunswik, 1953; Gigerenzer et al., 1999), physical configurations (e.g., Hutchins, 1995a/b; Suchman, 1986), and/or cultural beliefs and values (e.g., Geertz, 1983; Lave, 1987) prevailing in a particular task environment.

Second, it has been suggested in the literature on medical expertise (cf. Shalin & Bertram, 1996) – and confirmed by the observational study – that to identify and explain variability of physicians’ reasoning across different task settings and/or patients a *functional account* is most suited. Specifically, whereas the present study suggested that ED physicians’ goal is the adequate evaluation and disposition *not* the exact diagnosis of their patients (for related findings see Shalin & Bertram, 1996), most studies on medical decision making studied physicians’ skills at diagnosing a narrow range of medical problems such as pancreatitis (e.g., Boshuizen & Schmidt, 1992) or acute bacterial endocarditis (e.g., Patel & Groen, 1986; Schmidt, Boshuizen, & Hobus, 1988).

The social dynamics of emergency medicine

Finally, based on the present research, it can be said that to describe and understand reasoning in a social setting such as the ED, a functional account with an exclusive focus on safety and efficiency is *not* sufficient. Instead, functional behavior and performance can

only be understood by considering the constraints introduced by the social dynamics underlying effective cooperation between stakeholders in the work (e.g., care delivery) process. Several examples could be used to show that information provided by patients and other stakeholders may be ambiguous and/or misleading. This adds an additional level of complexity (or ‘ill-structure’) to the care delivery process, which makes information difficult to interpret for the physician. On one hand, there is evidence that ED physicians’ accepted method is built around a generally ‘cautious’ attitude with the goal to identify potential ‘worst cases,’ even if evidence is contradictory. On the other hand, the presented studies could be used to show that ED physicians’ understanding of their patients’ personality, personal circumstances, and needs for a ‘human connection’ (i.e., rapport) increases their ability to further delimit and specify the problem to be solved and select targeted strategies to address this problem. In other words, by being mindful about their patients’ stories, their needs, and concerns, ED physician are able to obtain more (and in some cases better) information that can be used to generate good first hypotheses about patients’ problems, possible solutions to these problems, and, ultimately, effective solution strategies.

In summary, physicians who listen to, care for, or increase participation of their patients in the care delivery process have been touted as ethically and/or morally desirable (cf. Charles, Gafni, & Whelan, 1997, 1999; for a review see Ong et al., 1995). Based on the present findings, it can be further suggested that ED physicians who are mindful about and understand their patients’ needs and circumstances are likely to obtain situationally relevant information that they can use to (more) accurately gauge the nature, severity, and acuity of their patients’ medical problems with all the implications for efficient and safe (i.e.,

ecologically rational) care delivery. In other words, a caring attitude and effective and safe emergency care are not contradictory but dynamically intertwined in a ‘good’ (i.e., ecologically rational) ED physician.

Practical Implications

From an applied perspective, this research has several implications. First, based on the evidence, it can be said that medical information is necessary to identify ‘worst cases’ but is *not* sufficient to deliver care reliably and safely under time and resource pressures. Instead, ecological constraints on what needs to be done and what can be done impact what is actually done in a particular situation. To support practitioners in identifying effectively and reliably what problems need to be solved in the ED, it is therefore essential to provide them with information about relevant ecological constraints and ways to acquire this information. This suggests that exclusive reliance on traditional medical education (e.g., pathophysiology, clinical algorithms) is insufficient. Instead, it should be complemented with training emphasizing the development of social skills that help to obtain more and potentially better information from the patient, and ultimately, to more effectively delimit the range of medical problems and identify targeted evaluation strategies.

Second, constraints on possible solutions to a patient’s problems not only impact the safety-efficiency tradeoff at the individual level of care delivery but also have potential implications for resource availability at the level of the ED/hospital and health care system. Thus, to improve resource allocation, it might be important to provide agents with information about the impact of their disposition decisions on the availability of resources at different levels of the health care system, for example, the unit of the ED/ hospital but also larger regional health care provider systems such as ‘trauma systems’¹¹⁷. Whereas

attempts are already being made to provide ED physicians with constraints on problems such as patients' previous medical histories and demographic information (e.g., efforts to implement electronic medical records), information about constraints on solutions are only scarcely available. Such constraints are mainly reflected in information pertaining to care logistics such as status information about current hospital (bed) capacities, laboratory and resource availabilities, as well as effective identification and contacting of patients' family physicians as well as consultants in the hospital.

Limitations, Advantages and Future Research

Limitations and advantages of the present research have been mentioned throughout the discussion of the results so they will not be repeated here in detail. Instead, the major threads will be emphasized with their implications for future research. The goal of this research was to better understand and describe bounded rationality in the ED. To do so, two methodological approaches were chosen, observation and experimentation. Specifically, observational methods were chosen to identify and understand the naturalistic dynamics underlying ED physicians' reasoning and decision making. Although observational methods provided an effective means to uncover the dynamic process ED physicians use to identify the problem to be solved and select ecologically rational heuristics, they were limited with respect to the level of control they offered. The 'experiment,' on the other hand, was designed to further disentangle the impact of certain characteristics of the patient (e.g., a stoic character) on ED physicians' reasoning and decision making. The main advantage of this study was that it could be performed with *actual* ED resident physicians. The main limitation, on the other hand, was that the experimental manipulation was ineffective. Therefore, the survey data provided converging but *no* conclusive evidence

with respect to the observational findings. In other words, the main limitation of this research project was that both parts – the observational *and* the survey study – were exploratory and descriptive in nature.

Thus, on the negative side, the presented results are tentative. Future research will be necessary to confirm observational findings in other settings and with a more diverse physician population. In addition, it will be necessary to complement observational methods with more rigorous experimentation. Specifically, the experiment planned for this study should be repeated with an effective manipulation of patient characteristics (for details see discussion of the survey study). In addition, the vignettes used to study ED physicians' reasoning and decision making should be chosen more carefully to represent a wider range of problems both in terms of the medical problem as well as the level of ambiguity inherent in the patient's complaint. Moreover, given that participants in the survey study were relatively homogenous with respect to differences in tenure as ED resident physicians, it will be necessary to sample a wider range of participants with more diverse levels of clinical experience to confirm the present findings. Finally, given the dynamic nature of emergency medicine, alternative methods such as simulation studies with longitudinal study designs should be explored.

On the positive side, both observations and the survey study provided complementary (i.e., a qualitative and a quantitative) descriptions of ED physicians' reasoning and decision making. Thus, the main advantage of having both qualitative and quantitative data was converging evidence, which could be used to gauge the meaningfulness of the survey data and specify some of the observational findings. Another particular benefit of the present research is that it will help to constrain the very broad,

exploratory approach taken for the present research by pointing to promising areas for future research. Given a scarcity of prior research and the practical implications of this topic, one area of particular interest is exactly how ED physicians (re)structure the range of possible solutions to a patient's problem, the range of constraints they consider to do so, and how they use the so structured solution space to allocate resources across different levels of the health care system.

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APPENDIX I.1

Recruitment Email to Potential Participants

Dear ED expert,

We are a group of human factors researchers from WSU working with Drs. Hamilton, Brown, and Springer to investigate two aspects of ED physicians' reasoning skills. First, physicians are often faced with ill-structured problems. We are interested in how ED physicians *approach and solve every-day problems* related to patient management. Second, we are interested in the development of *expertise in the ED*. So far, we had the chance to work mainly with resident physicians on duty in the ED at either Good Samaritan or Kettering hospital. **Now, we hope to learn from the experts!**

The WSU research team consists of 4 members:

Markus Feufel (Graduate student): feufel.2@wright.edu
Eric Robinson (Graduate student): robinson.191@wright.edu
John Flach (Professor): john.flach@wright.edu
Valerie Shalin (Professor): valerie.shalin@wright.edu

If you are interested and willing to have one of us come in for observations, the respective observer will be your shadow for one shift that we can schedule at your convenience. To help you decide, we attached a short summary of the research goals and methods as well as the IRB requirements for this study. Thank you for considering our request!

Study purpose:

This study is designed to analyze behavioral and reasoning processes involved in effectively evaluating, treating, and managing ED patients. The focus of this study is to understand physicians' *problem solving skills* (e.g., how do physicians structure evaluation and treatment processes given the particular needs of their patients and the pressures prevalent in the ED) and the *development of expertise* in emergency medicine. Insight into the realities of patient management may yield a basis for designing effective training interventions and evaluating the impact of technologies such as EMR systems on the daily practice in the ED.

Method:

This research involves observations of ED physicians in their every-day work environment (the ED) and during situations that require patient evaluation, treatment, and disposition decisions. During a normal work shift, one participant at a time will be shadowed. Notes will be taken of observable behaviors and verbalized thoughts. Questions to clarify work/thought processes may be asked at a convenient time and location.

Participation is voluntary. There are no benefits or disadvantages associated with your decision to participate or refrain from doing so. Study results will be available in aggregated form without personal identifiers.

If you agree to take part in this study, you will be asked to do the following:

1. You will be shadowed by a researcher for the duration of a single work shift.
2. Prior to any patient interactions, you will inform each patient that:
 - a. You are being shadowed for a research study of emergency physicians.
 - b. You request permission for the researcher to observe your interaction with the patient.
 - c. No patient information is being collected.
 - d. The patient is free to allow/refuse the observations w/o affecting their care in any way
 - e. The patient may change his/her mind about the observation at any time.

APPENDIX I.2
CONSENT TO PARTICIPATE IN RESEARCH
Department of Psychology
Wright State University
Dayton, OH 45435

Title of study	Emergency Department Decision Making
Consent to participate	<p>This signed consent is to certify my willingness to participate in this observational study.</p> <p>I am free to refuse to participate in this study or to withdraw at any time.</p> <p>My decision to participate will not incur compensation of any kind.</p> <p>My decision to not participate will not incur penalties of any kind.</p>
Purpose of research	<p>The purpose of this study is to gain a better understanding of how emergency department staff make decisions with the goal to effectively manage emergency department patients.</p>
Procedures	<p>During the study, I will be observed during one normal work shift and occasionally asked clarifying questions about my work processes.</p>
Risks/Benefits	<p>There are no anticipated risks associated with this study.</p> <p>The benefits of this study may include an increased understanding of decision making processes associated with effectively managing emergency department patients.</p>
Confidentiality	<p>I understand that any information about me and the patients I treat that is obtained from this study will be kept strictly confidential.</p> <p>I understand that all collected materials (i.e. observational notes) will be kept in a secure location and will only be available to the researchers.</p> <p>I understand that I will NOT be identified in any report or publication.</p>
Availability of results	<p>A summary of the study results may be requested by contacting the researchers listed below. The summary will show only aggregated (i.e., combined) data for the entire sample. No individual results will be available. The results of this study will be available after March, 2009.</p>
Questions/Complaints	<p>If I have questions about this study or have research-related complaints I can contact the researchers Markus Feufel, John M. Flach, or Valerie L. Shalin at 937-775-2391.</p> <p>If I have general questions about giving consent or my rights as a research participant in this study, I can call the Wright State University Institutional Review Board at 937-775-4462.</p>

My signature below means that I have freely agreed to participate in this observational study.

Participant

Date

Participant Name (Printed)

Investigator

APPENDIX II.1

Sample Protocol

Time observed	Logged information
00:00	<p>RES talks to ATT about his 1st PT, a female w/ hip/knee problems</p> <p>ATT: no redness or swelling? No</p> <p>Does she have crutches at home? Give her an ACE wrap and Percocet</p> <p>RN to RES: does she have a ride? [meds can make drowsy]</p> <p>RES to me: PT doesn't want an x-ray, MRI cannot be done here</p> <p>Have to give her meds (narcotics), oral meds... pills, one for here and some for home [2-3 days worth of meds]</p> <p>RES: That's a scam but I cannot prove it. I checked in computer but her record doesn't show that she is collecting drugs all over... her husband has a history of narcotics abuse, but then, they have been apart for 5 years.</p> <p>Waiting for new PT</p>
Waiting room is empty (only 3 patients waiting), all beds occupied	
34:00	New male PT: has pain behind his left knee and his left shoulder hurts
35:00	<p>PT has no room #. RES: I have no idea where this PT is.</p> <p>RES asks another MD</p>
35:30	<p>He is at C3, which is on the hallway.</p> <p>PT got in a car wreck. He explains the accident (RES not interested) and that he hit his head (not very hard though), shoulder (he cannot lift his right shoulder), and hip (from lap belt) and he has pain behind his right knee (that is his main complaint): Maybe I stretched it, tweaked it.</p> <p>RES: Do you drink? [Pt looks like he could be an alcoholic]</p> <p>PT: NO, no drugs</p> <p>Physical exam: RES touches PT's shoulder, asks PT to lift his arms in front and to the side, and behind the back. When the PT puts his arm behind the head. Uhh, that hurts!</p> <p>PT: I can drive ok but walking is bad w/ my knee</p> <p>RES checks eyes: no blurry vision, double vision? No. Please follow my finger, do you feel me touching your feet? Yes.</p> <p>How about pain meds?</p> <p>PT: I took 800 mg ibuprofen</p> <p>I thought I have gout in my feet so I didn't think about it [the pain] but my neighbor said you better go, something may be wrong w/ you ... [seems like he is trying to provide an explanation/justification for why he came in]</p> <p>RES: I suggest I give you more ibuprofen (800mg) to "get you under control" I will ask my boss what to do and I will get your paper work done. []</p>
...	

↑
A stop watch was used to collect generic time stamps.

↑
Column with logs of observed behavior, verbal & non-verbal communications, and situation-specific events (e.g., # of open beds, patients in the waiting room)

APPENDIX IV.1

Advertisement for Vignette Writing Contest

Tell the true story about ER physicians and win a \$50 gift card!!

The task:

Tell a story that characterizes an ER physician who is or is not particularly well attuned to the intricacies of emergency medicine as it is actually practiced. You can think of writing a script for “Grey’s anatomy” or “ER” that is telling the “true” story about ER physicians. You may focus your story on the well-attuned physician, a physician who is not, or both.

Your story may begin with:

Dr. Champ comes to work and... whereas Dr. Absent comes to work and...

The format:

The story should be told from the perspective of a 3rd person (e.g., Dr. Champ talks to the nurse) without personally identifying any characters.

The story may reflect your personal experience but can contain fictional elements.

You may work alone or as a team.

There are no limits or requirements in terms of word count.

A preliminary ***deadline is December 24***. Later dates are possible.

The reward:

The best story will win a ***\$50 gift card*** for your store of choice!!!

What is this about?

My name is Markus Feufel. I’m a human factors graduate student at WSU. This story-telling task will be part of my dissertation project.

If you have questions, comments, or a good story you can reach me via email at feufel.2@wright.edu or phone at 937-344-4710.

I’m looking forward to hearing from you!!

APPENDIX IV.2

Vignette Writing Contest Winner – Original Vignette

In the era of new technologies and advanced gadgetry, medical professionals have new tools at their disposal to aid in the care of their patients, throwing light onto the previous shadows of uncertainty. For all the sophisticated robotics and advanced, the biggest diagnostic tool still remains the patient. Listening, observing, talking to the patient are still the most important skills any provider can have. Unfortunately, these skills are usually the least used.

Dr. Black had had a helluva night. The bus had arrived around midnight and it hadn't stopped since. He was extended beyond the max. Everyone had been running at full speed. He wasn't even sure when the last time was that he had been to the bathroom. Food was not an option at this point.

Edsell was about 48. He was a blue collar worker, very stoic. He came in because he just didn't feel right, but his main complaints were nausea and vomiting. He had been waiting two hours to go back. His wife had gone up once to the desk and asked about the wait. The triage nurse had already snapped twice about busy and people being in order of priority. Around six am, Edsell was taken back to the back room.

Dr. Black wanted to wait. He wanted the next shift to take the chart that was sitting in his rack. He wasn't so sure he had enough coherent thoughts left. The NA came around the corner.

"34 is vomiting. Can he have some Phenergan and fluids? Sally wants me to run an abdominal panel."

"Is he having any pain or anything like that?"

"No."

"Then why would you run all that?"

"Nausea, vomiting."

"How are his vitals?"

"Fine."

"(huff) Let me go see him." He grabbed the chart, his t-sheet, and busted around the corner to the minor complaint pod. "Hello Sir. I'm Dr. Black. What's going on today?" he asked, shaking his hand then clicking his pen.

"I woke this morning, puking. I haven't been able to stop. My wife wanted me to come in."

"Did you feel bad last night?"

"Not really." He scribbled some. He glanced up once. Edsell didn't look so hot. He wiped his mouth and looked at Dr. Black. He was a little grey.

"No indigestion? Or chest burning or anything?"

"A little bit of chest ... uncomfortableness."

"Okay. Do you have any history of reflux disease or GERD?"

"No."

"What about heart disease?"

"None."

“Any pain in the chest?”
 “No...” He waited. “I mean it’s a little tight up here by my left shoulder.”
 “Did you have that last night?”
 “Nah.” He rubbed his shoulder. Dr. Black changed his tone to be a little more inviting. There was obviously something Edsell wasn’t telling him.
 “What did you have to eat last night?”
 “Just chicken and broccoli.”
 “Do you have any other medical history?”
 “No.”
 “Any surgery?”
 “No.”
 “Do you smoke or drink?”
 “No.”
 “Tell me about your shoulder tightness.”
 “Probably just slept wrong on it.”
 “Maybe.” He gently tapped parts of his shoulder and his chest. “Does this hurt?”
 “No...”
 “Tell me about the tightness.”
 “It’s nothing really.” Dr. Black smiled at him. “Well it just...” He cleared his throat. That was the third time he had done it.
 “Does it feel like...you can’t ... clear your throat? Like maybe something is stuck?”
 “Yeah a little. You think I might have some chicken stuck?”
 “Have you had fluids?”
 “Yes.”
 “No problems swallowing?”
 “No.”
 “Then you’re okay. Let me have a listen. Do you take any medicine?”
 “No.” He listened to his lungs.
 “Any family history of heart disease, diabetes, anything like that?”
 “No.”
 “Okay. I’m going to get a couple tests.”
 “What do you think it is? I just think I have a bug or something.”
 “Well, let’s just do a couple things okay?” He walked out, scribbling on his t-sheet. He snagged the NA. “I want a stat EKG in there.”
 “For the puker?” she asked.
 “I think he’s having an MI.” She seemed shocked and hurried to get the EKG machine. He pattered over to the secretary. “Get me a cardiac panel with coags. I want the chest xray stat please.”
 “What are you thinking?”
 “MI until proven otherwise.”
 “I didn’t think he had chest pain.”
 “He doesn’t. Something about him...he had that look, and he’s having shoulder tightness...Dorene, line and labs stat please.”
 Dr. Black waited near the room. The aide came out with the MI. He glanced down. BIG tombstones of ST elevation jabbed across the page.

“ I’ll be damned. Dorene! AMI! Jackie! I need cardiology stat, and call the cath lab.” He moved back into the room. “ Sir? Your EKG shows you are having an myocardial infarction, a heart attack.” His wife collapsed into the chair. “ Things are going to move really fast. The cardiologist is paged. The cath lab team is notified. They’re going to draw blood and start giving meds.” Edsell looked shocked. “ Any chest pain?”

“ Well, I didn’t want to complain, but yeah I had a little tickle here. I thought with heart attacks you have a lot of chest pain.”

“ Some people do.” He was called out for the cardiologist. “ Dorene. Integrilin. Aspirin. Nitro.” He spoke with the cardiologist, and listened as the clippers hummed in Edsell’s room. He came back in to check on him. “ How are you feeling?”

“ Scared a little. I just thought I ate something. My wife made me come in.”

“ She just saved your life.”

“ How did you know?”

“ You were a certain shade of grey. When you told me that shoulder pain, you kept clearing your throat like you had a tickle or something there. You’re a pretty solid stoic man.” He patted his leg. “ The cardiologist is on his way down.” Speak of the devil, the cardiologist, still in his scrubs from an earlier case, came busting in. He introduced himself and they started to talk. Dr. Black went out to finish his paperwork and look at the chest x-ray to make sure they could give Heparin. He saw the unmistakable blue scrubs of the cath team as they walked into his pod with portable monitor in hand. He pointed the way. Edsell was whipped out of the room and down to the cath lab for a stat angioplasty.

Dr. Black, coat on, worn and weary, trudged down to the ambulatory surgery waiting room to check on Edsell’s wife. She was sitting with two teenage children, staring at the wall.

“ Ma’am?”

“ Doctor.”

“ Has anyone been out yet?”

“ Yes. He is on his way to the operating room for open heart. The doctor said that his arteries looked terrible. You know he’s been having some chest pains for the past couple weeks, but he’s put off going to the doctor because he’s been doing a lot of overtime.” He sat down next to her. “ I never...I almost let him talk me out of coming in. The cardiologist said he’d be dead if I hadn’t. How did you know? The nurses didn’t seem to think anything was wrong.” He explained the concept of triage, and how his vitals had been stable, he hadn’t complained of pain, nothing to set it off. “ Then how did you know?”

“ I looked at the patient. He was grey. He was an undeniable shade of grey that made me think something bigger than what he had said was going on. I asked him questions. He doesn’t seem like a guy who complains.”

“ He doesn’t.”

“ Those are the hardest to read. That’s why you have to ask the right questions, go with your gut. I have to go. I’m about to fall asleep. Good luck to you, and I’ll check on you when I come back tonight. Do have any questions for me?” She shook her head. He patted her shoulder and stood to leave.

“ Thank you.”

“ You’re welcome.” He walked off down the cold marble hallway.

APPENDIX IV.3

Questionnaire Used for the Survey Study

CONSENT TO PARTICIPATE IN RESEARCH

Department of Psychology
Wright State University
Dayton, OH 45435

Title of study	Patient Management in the Emergency Department – A survey study
Consent to participate	<p>This signed consent is to certify my willingness to participate in this survey study.</p> <p>I am free to refuse to participate in this study or to withdraw at any time.</p> <p>I will not be paid or compensated for participating. If I decide not to participate, or not to complete the surveys, I am free to so do without penalty.</p>
Purpose of research	<p>The purpose of this study is to gain a better understanding of the reasoning processes emergency department physicians use to effectively manage their patients.</p>
Procedures	<p>For this study, I will have to rate my impressions and respond to a few open-ended questions with respect to one medical case description. Further, I will have to fill out two short attitude questionnaires and a demographic survey.</p> <p>This study should take 20 to 30 minutes to complete. If I choose, I can skip any question I do not wish to answer, or can stop participating at any time.</p> <p>If I choose to participate, I have the option to make my score on the in-service exam available for this research.</p>
Risks/Benefits	<p>There are no recognized risks in participating.</p> <p>The benefits of this study may include an increased understanding of physicians' reasoning processes associated with effectively managing emergency department patients.</p>
Confidentiality	<p>I understand that any information that is obtained from this study will be kept strictly confidential. I understand that all collected materials will be kept in a secure location and will only be available to the researchers. I understand that I will NOT be identified in any report or publication.</p>
Availability of results	<p>A summary of the study results may be requested by contacting the researchers listed below. The summary will show only aggregated (i.e., combined) data for the entire sample. No individual results will be available. The results of this study will be available after April 2009.</p>
Questions or complaints	<p>If I have questions about this study or have research-related complaints I can contact the researchers Markus Feufel at feufel.2@wright.edu or John M. Flach, PhD at 937-775-2391 or john.flach@wright.edu. If I have general questions about giving consent or my rights as a research participant in this study, I can call the Wright State University Institutional Review Board at 937-775-4462.</p>

My signature below means that I have freely agreed to participate in this study...

☐ **AND release my score on the in-service exam for the purpose of this research. My identifier #: _____**

☐ **but DO NOT wish to release my score on the in-service exam for the purpose of this research.**

I will be given a copy of this consent form, which is attached at the end of this package.

Participant's signature

Date

Participant's name (Printed)

Instructions:

*Below you will find two parts of a medical case. Please read Part I first. On the following pages, you will find a couple of questions pertaining to Part I. Please take a few minutes to respond to these questions. Continue reading Part II ONLY after you finished Part I. There will be **one** follow-up question after Part II of the medical case. Following Part II of the case description you will be asked to fill out two short questionnaires and a demographic survey. **Thank you** for your participation!!*

Part I:

Dr. Black had a helluva night. The bus had arrived around midnight and it hadn't stopped since. He was extended beyond the max. Everyone had been running at full speed. He wasn't even sure when the last time was that he had been to the bathroom. Food was not an option at this point.

Edsel was about 48.[He was a blue collar worker and a very stoic person] OR [He was a white collar worker and a very apprehensive person] OR []. His wife brought him in because he just didn't feel right; his main complaints were nausea and vomiting. He had been waiting two hours to go back. His wife had gone up once to the desk and asked about the wait. The triage nurse was busy and had already told her: "You'll have to wait until it's your turn. People are called in order of priority." Around 6:00am, Edsel was taken back into the treatment area.

Dr. Black wanted to wait. He wanted the next shift to take Edsel's chart that was sitting in his rack. He wasn't so sure he had enough coherent thoughts left. The NA came around the corner.

"34 is vomiting. Can he have some Phenergan and fluids? Sally wants me to run an abdominal panel."

"Is he having any pain or anything like that?"

"No."

"Then why would you run all that?"

"Nausea, vomiting."

"How are his vitals?"

"Fine."

"(huff) Let me go see him." He grabbed the chart and busted around the corner to the minor complaint pod. "Hello Sir. I'm Dr. Black. What's going on today?" he asked, shaking his hand then clicking his pen.

"I woke this morning, puking. I haven't been able to stop. My wife wanted me to come in."

"Did you feel bad last night?"

Edsel cleared his throat.

"Not really."

Dr. Black scribbled some. He glanced up once. Edsel didn't look so good.

"No indigestion? Chest burning or anything?"

"I feel a little uncomfortable up here..." Edsel pounded on his upper chest.

"Okay. Do you have any history of reflux disease or heartburn?"

"No."

"What did you have to eat last night?"

"Just chicken and broccoli."

"What about heart disease?"

"None."

"Any pain in the chest?"

"... a little tight maybe?"

"Did you have that last night? Tell me about it..."

"Nah." He rubbed his shoulder. "Probably just slept wrong on it."

Dr. Black gently tapped parts of Edsel's shoulder and chest: "Does this hurt?"

"No..." He cleared his throat again.

"... you have problems clearing your throat? ... as if something is stuck?"

"... a little. You think I might have some chicken stuck?"

"Have you had fluids?"

“ Yes.”
“ No problems swallowing?”
“ No.”
“ Then you’re okay. Let me have a listen. Do you take any medicine?”
“ No.” Dr. Black listened to Edsel’s lungs.
“ Any family history of heart disease, diabetes, anything like that?”
“ No.”
“ Do you have any other medical history?”
“ No.”
“ Do you take any medication? ...any recent changes in medication?”
“ No.”
“ Any surgery?”
“ No.”
“ Do you smoke or drink?”
“ No.”
“ Okay. I’m going to get a couple tests.”
“ Well, ...I just think I have a bug or something.”
“ Let’s just do a couple things, okay?”
“ What are you planning to do, doctor?”

Please respond to the following questions without spending too much time on any single answer. Your responses should reflect your genuine impressions of the described case.

1. Having read this story, what are the first thoughts coming to your mind with respect to this patient and his complaint?

2. Based on the information provided, how confident are you that you have a good grasp of the patient's complaint?

Very unsure *Very confident*
 1 2 3 4 5 6 7 8 9 10

3. With what you know from the story, what would you say is the likelihood that this patient will stay in the hospital - ranging from 0% (the patient will surely go home) to 100% (the patient will definitely stay)?

Your best-guess between 0% and 100% for a 23-hour admission: _____ %

Your best-guess between 0% and 100% for a FULL admission: _____ %

4. Based on your first impression, how much time (in minutes) will this case likely take? _____ minutes

- 5a. Based on the situation described in the story, what are your major concern(s) for this patient?

- 5b. Please provide a short rationale for your major concern(s):

6. In cases like this, how important do you consider the following aspects of the doctor-patient interaction?

	<i>Very unimportant</i>								<i>Very important</i>	
The patient's ability to articulate their complaints	1	2	3	4	5	6	7	8	9	10
The patient's physical symptoms	1	2	3	4	5	6	7	8	9	10
The patient's personality	1	2	3	4	5	6	7	8	9	10
The patient's social background	1	2	3	4	5	6	7	8	9	10
The doctor's listening skills	1	2	3	4	5	6	7	8	9	10
The doctor's medical expertise	1	2	3	4	5	6	7	8	9	10
The doctor's intuition	1	2	3	4	5	6	7	8	9	10
The doctor's people skills	1	2	3	4	5	6	7	8	9	10
	<i>Very unimportant</i>								<i>Very important</i>	

- 6b. Please provide a short explanation for your ratings in 6:

7. With the story in mind, what would you order for this patient?

LAST NAME		FIRST NAME		SEX	AGE	EDP TO Rx <input type="checkbox"/> YES <input type="checkbox"/> NO	ED BED:	TIME IN BED:
INITIAL DOCTOR ORDER TIME:	DOCTOR SEEN TIME	REASON FOR SEEKING TX:					PREP BED TIME: SQUAD SCREEN TIME:	
LAB		RADIOLOGY		NURSING ORDERS		ADDITIONAL ORDERS:		
<input type="checkbox"/> Amylase <input type="checkbox"/> Lipase <input type="checkbox"/> Alcohol <input type="checkbox"/> Basic Metabolic Panel <input type="checkbox"/> Blood Culture x q <input type="checkbox"/> Blood Sugar <input type="checkbox"/> BUN/Cr <input type="checkbox"/> Lytes <input type="checkbox"/> CBC <input type="checkbox"/> CPK - Total <input type="checkbox"/> BNP <input type="checkbox"/> D-Dimer <input type="checkbox"/> Dig Level <input type="checkbox"/> Dilantin Level <input type="checkbox"/> CA <input type="checkbox"/> Mg <input type="checkbox"/> Phos <input type="checkbox"/> Ketones <input type="checkbox"/> Lactate <input type="checkbox"/> Liver Profile <input type="checkbox"/> Ammonia <input type="checkbox"/> Pregnancy Test <input type="checkbox"/> Urine <input type="checkbox"/> Serum <input type="checkbox"/> Quantitative HCG <input type="checkbox"/> PT / INR <input type="checkbox"/> PTT <input type="checkbox"/> STD Screen <input type="checkbox"/> Wet Prep <input type="checkbox"/> Strep. Screen <input type="checkbox"/> Toxicology Screen <input type="checkbox"/> urine <input type="checkbox"/> blood <input type="checkbox"/> Type & Cross #units: <input type="checkbox"/> Hold <input type="checkbox"/> Transfuse <input type="checkbox"/> Type & Screen <input type="checkbox"/> Type and Rh <input type="checkbox"/> Urinalysis <input type="checkbox"/> mini <input type="checkbox"/> foley <input type="checkbox"/> cc <input type="checkbox"/> mini if unable to get prompt cc <input type="checkbox"/> Urine C & S <input type="checkbox"/> Other		X-RAY <input type="checkbox"/> CXR <input type="checkbox"/> Portable <input type="checkbox"/> PA/LAT <input type="checkbox"/> Trauma C-Spine <input type="checkbox"/> C--Spine <input type="checkbox"/> T-Spine <input type="checkbox"/> LSS <input type="checkbox"/> Pelvis Extremity Shoulder R L Elbow R L Wrist R L Hand R L Hip R L Knee R L Ankle R L Foot R L <input type="checkbox"/> Acute Abdomen <input type="checkbox"/> Flat and Upright <input type="checkbox"/> KUB <input type="checkbox"/> Other Rationale: <input type="checkbox"/> Pain <input type="checkbox"/> Trauma <input type="checkbox"/> N+V <input type="checkbox"/> SOB <input type="checkbox"/> Fever <input type="checkbox"/> Cough <input type="checkbox"/> Abnormal Lung Sounds <input type="checkbox"/> Mass <input type="checkbox"/> Bleeding <input type="checkbox"/> Distension <input type="checkbox"/> Constipation <input type="checkbox"/> Diarrhea <input type="checkbox"/> Swelling <input type="checkbox"/> Deformity <input type="checkbox"/> Possible FB <input type="checkbox"/> Other CT SCAN <input type="checkbox"/> Head <input type="checkbox"/> ABD/Pelvis <input type="checkbox"/> Chest - PE Protocol <input type="checkbox"/> Other		<input type="checkbox"/> Suture Set-up <input type="checkbox"/> Prep: <input type="checkbox"/> Betadine <input type="checkbox"/> Sur-Clens <input type="checkbox"/> Gloves: 6 6.5 7 7.5 8 <input type="checkbox"/> Local: Lidocaine 1% 2% Epi Marcaine 0.25% .5% Other: <input type="checkbox"/> Suture <input type="checkbox"/> Nylon 4.0 5.0 6.0 <input type="checkbox"/> Prolene 4.0 5.0 6.0 <input type="checkbox"/> Vicryl 4.0 5.0 6.0 <input type="checkbox"/> Maxon/PDS 4.0 5.0 6.0 <input type="checkbox"/> ABG <input type="checkbox"/> RA <input type="checkbox"/> O2 @ <input type="checkbox"/> Accu Check <input type="checkbox"/> EKG <input type="checkbox"/> Repeat EKG @ 90 min. <input type="checkbox"/> Foley <input type="checkbox"/> Leg Bag <input type="checkbox"/> Monitor <input type="checkbox"/> Oxygen @ <input type="checkbox"/> Orthostatics <input type="checkbox"/> Pelvic Exam Setup <input type="checkbox"/> Pulse Ox IV: <input type="checkbox"/> Saline lock <input type="checkbox"/> NS @ <input type="checkbox"/> Banana Bag <input type="checkbox"/> Other <input type="checkbox"/> Seizure Precautions <input type="checkbox"/> Splint <input type="checkbox"/> Td <input type="checkbox"/> Triage Medical Directive:		Time Triage Prep: <input type="checkbox"/> Labs <input type="checkbox"/> Urine <input type="checkbox"/> IV <input type="checkbox"/> Blood Cx		
PANELS		ULTRASOUND		SECRETARIAL ORDERS				
<input type="checkbox"/> Abdominal Panel <input type="checkbox"/> Abdominal Panel with (Preg. test) <input type="checkbox"/> Cardiac Alert - Notify Cath Lab <input type="checkbox"/> Cardiac Panel With Coags <input type="checkbox"/> Cardiac Panel Without Coags <input type="checkbox"/> Hyper Acute Stroke Path - Notify Team <input type="checkbox"/> Sepsis Panel <input type="checkbox"/> Stroke Panel with Coags <input type="checkbox"/> Stroke Panel without Coags <input type="checkbox"/> Trauma Panel <input type="checkbox"/> WD Panel with CT Scan <input type="checkbox"/> WD panel no CT Scan <input type="checkbox"/> Triage Panel Cardiac and BNP <input type="checkbox"/> Triage Panel Cardiac <input type="checkbox"/> Triage Panel Cardiac at 90 minutes <input type="checkbox"/> Other		Contrast <input type="checkbox"/> None <input type="checkbox"/> IV <input type="checkbox"/> Oral Rationale: <input type="checkbox"/> Possible Stone <input type="checkbox"/> Hematuria <input type="checkbox"/> Stroke/TIA <input type="checkbox"/> Pain <input type="checkbox"/> Altered LOC <input type="checkbox"/> Dizziness <input type="checkbox"/> Other <input type="checkbox"/> R/O PE <input type="checkbox"/> Absent FHT <input type="checkbox"/> R/O DVT <input type="checkbox"/> R/O Ectopic <input type="checkbox"/> R/O Aortic Dissection <input type="checkbox"/> Other <input type="checkbox"/> R/O Stone		<input type="checkbox"/> Resp Protocol <input type="checkbox"/> Peak Flow <input type="checkbox"/> Old Records <input type="checkbox"/> Copies of X-Rays <input type="checkbox"/> MH Consult <input type="checkbox"/> Contact TIME		<input type="checkbox"/> Disposition @		
Rx GIVEN:								
DISCH	Departure Time		ROOM #	ROOM #	<input type="checkbox"/> ADM <input type="checkbox"/> OBS <input type="checkbox"/> Home <input type="checkbox"/> Transfer <input type="checkbox"/> Drs. Office <input type="checkbox"/> DAA <input type="checkbox"/> AMA <input type="checkbox"/> LWOT			
	Condition at Discharge or Transfer <input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor <input type="checkbox"/> Critical		ER PHYSICIAN:					
	PRIVATE PHYSICIAN:		RESIDENT / PA / ATTENDING INITIALS:		STAMPED NAME:			

8a. What clue(s) did you consider relevant for the evaluation of this patient?
Please rate the importance you associate with the clue(s) on the provided scale.

	<i>Somewhat Important</i>					<i>Very important</i>	
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>
_____	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>
_____	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>
_____	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>
_____	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>
_____	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>

8b. If any, what additional information would you have asked/looked for when evaluating this patient?








8c. Please provide a short explanation for why you consider the information in 8a and 8b relevant:

8d. Is there anything else you would have done differently during a first encounter with this patient?

9. How confident are you that your overall evaluation and treatment plan will be successful?

<i>Very unsure</i>										<i>Very confident</i>
<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>10</i>	

10. Please indicate how satisfied you are with the overall evaluation and treatment plan you developed?

						
<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>
<i>Very satisfied</i>						<i>Very dissatisfied</i>

End of Part I

Please make sure you have
completed Part I before
continuing!

Part II:

Please do **NOT** go back to Part I once you decided to continue!

...Dr. Black snagged the NA. "I want a stat EKG in there."

"For the puker?" she asked.

"I think he's having an MI." She seemed shocked and hurried to get the EKG machine. He walked over to the secretary. "Get me a cardiac panel with coags. I want the chest xray stat please."

"What are you thinking?"

"MI until proven otherwise."

"I didn't think he had chest pain."

"He doesn't. Something about him...he had that look, and he's having "a little" shoulder tightness...Dorene, line and labs stat please."

Dr. Black waited near the room. The aide came out with the EKG. He glanced down. BIG tombstones of ST elevation jabbed across the page.

"I'll be damned. Dorene, a MI! Jackie! I need cardiology stat, and call the cath lab." He moved back into the room. "Sir? Your EKG shows you are having an myocardial infarction, a heart attack." His wife collapsed into the chair. "Things are going to move really fast. The cardiologist is paged. The cath lab team is notified. They're going to draw blood and start giving meds." Edsel looked shocked. "Any chest pain?" "Well, I didn't want to complain, but yeah I had a little tickle here. I thought with heart attacks you have a lot of chest pain."

"Some people do..." He was called out for the cardiologist. "Dorene. Integrilin. Aspirin. Nitro." He spoke with the cardiologist, and listened as the clippers hummed in Edsel's room. He came back in to check on him. "How are you feeling?"

"Scared a little. I just thought I ate something. My wife made me come in."

"She just saved your life."

Dr. Black patted his leg. "The cardiologist is on his way down." Speak of the devil, the cardiologist, still in his scrubs from an earlier case, came busting in. He introduced himself and they started to talk. Dr. Black went out to finish his paperwork and look at the chest x-ray to make sure they could give Heparin. He saw the unmistakable blue scrubs of the cath team as they walked into his pod with portable monitor in hand. He pointed the way. Edsel was whipped out of the room and down to the cath lab for a stat angioplasty. Dr. Black, coat on, worn and weary, trudged down to the ambulatory surgery waiting room to check on Edsel's wife. She was sitting with two teenage children, staring at the wall.

"Ma'am?"

"Doctor."

"Has anyone been out yet?"

"Yes. He is on his way to the operating room for open heart. The doctor said that his arteries looked terrible. You know he's been having some chest pains for the past couple weeks, but he's put off going to the doctor because he's been doing a lot of overtime." Dr. Black sat down next to her.

"I never...I almost let him talk me out of coming in. The cardiologist said he'd be dead if I hadn't. How did you know? The nurses didn't seem to think anything was wrong." Dr. Black explained the concept of triage, and how Edsel's vitals had been stable, he hadn't complained of pain, nothing to set it off.

"Then how did you know?"

What would you say is this physician's 'secret,' how did Dr. Black know?

APPENDIX IV.3.1

The Mindfulness/Mindlessness Scale (MMS)

Please rate the extent to which you agree with each of the following statements.

	<i>Strongly disagree</i>	<i>Disagree</i>	<i>Slightly disagree</i>	<i>Neutral</i>	<i>Slightly Agree</i>	<i>Agree</i>	<i>Strongly agree</i>
I like to investigate things.	1	2	3	4	5	6	7
I generate few novel ideas.	1	2	3	4	5	6	7
I am always open to new ways of doing things.....	1	2	3	4	5	6	7
I “get involved” in almost everything I do.	1	2	3	4	5	6	7
I do not actively seek to learn new things.	1	2	3	4	5	6	7
I make many novel contributions.....	1	2	3	4	5	6	7
I stay with the old tried and true ways of doing things.....	1	2	3	4	5	6	7
I seldom notice what other people are up to.....	1	2	3	4	5	6	7
I avoid thought provoking conversations.....	1	2	3	4	5	6	7
I am very creative.....	1	2	3	4	5	6	7
I can behave in many different ways for a given situation.....	1	2	3	4	5	6	7
I attend to the “big picture”	1	2	3	4	5	6	7
I am very curious.....	1	2	3	4	5	6	7
I try to think of new ways of doing things.	1	2	3	4	5	6	7
I am rarely aware of changes.....	1	2	3	4	5	6	7
I have an open mind about everything, even things that challenge my core beliefs.	1	2	3	4	5	6	7
I like to be challenged intellectually.....	1	2	3	4	5	6	7
I find it easy to create new and effective ideas.....	1	2	3	4	5	6	7
I am rarely alert to new developments.....	1	2	3	4	5	6	7
I like to figure out how things work.....	1	2	3	4	5	6	7
I am not an original thinker.....	1	2	3	4	5	6	7
	<i>Strongly disagree</i>	<i>Disagree</i>	<i>Slightly disagree</i>	<i>Neutral</i>	<i>Slightly Agree</i>	<i>Agree</i>	<i>Strongly agree</i>

APPENDIX IV.3.2

The Revised Short Version of the Health Care Climate Questionnaire (HCCQ)

Instructions: Please rate the extent to which you agree with each of the following statements. Your responses are **confidential!** Data will be aggregated and cannot be associated with you as an individual. Please read the statements carefully and respond frankly.

	<i>Strongly disagree</i>	<i>Disagree</i>	<i>Slightly disagree</i>	<i>Neutral</i>	<i>Slightly Agree</i>	<i>Agree</i>	<i>Strongly agree</i>
I feel that I provide my patients with choices and options.....	1	2	3	4	5	6	7
I try to understand how my patients see things before suggesting what to do.....	1	2	3	4	5	6	7
I don't convey confidence in my patients' abilities to deal with their situation.....	1	2	3	4	5	6	7
I feel that I understand my patients.....	1	2	3	4	5	6	7
Even if busy, I encourage my patients to ask questions.....	1	2	3	4	5	6	7
I listen to how my patients would like to have things done.....	1	2	3	4	5	6	7
I cannot handle peoples' emotions very well.....	1	2	3	4	5	6	7
I make sure my patients really understand about their condition and what needs to be done.....	1	2	3	4	5	6	7
Even if I disapprove of my patient's behavior, I feel that I accept my patients...	1	2	3	4	5	6	7
I feel very good about the way I talk to my patients.....	1	2	3	4	5	6	7
If pressed for time, I don't answer my patient's questions fully and carefully.....	1	2	3	4	5	6	7
I feel I care about my patients as individuals.....	1	2	3	4	5	6	7
	<i>Strongly disagree</i>	<i>Disagree</i>	<i>Slightly disagree</i>	<i>Neutral</i>	<i>Slightly Agree</i>	<i>Agree</i>	<i>Strongly agree</i>

APPENDIX IV.3.3

Demographic Survey

Sex: ☐ Female ☐ Male

Age:

Place of birth:

Current status: ☐ 4th-year med student ☐ R1 ☐ R2 ☐ R3 ☐ Attending since:

Undergraduate training: University: Major(s): Graduation year:

Medical school: University: Med school GPA: Graduation year:

Professional experience outside emergency medicine:

APPENDIX V.1
Contingency Tables for Qualitative Differences in Participants' Responses

<i>RC</i>				<i>Clues</i>				<i>Attitudes/Intentions</i>					
		SC		C		D		A		S		R	
		N	Y	N	Y	N	Y	N	Y	N	Y	N	Y
<i>CC</i>		10	29	23	16	13	26	27	12	28	11	27	12
Stoic character (S)	N	10		6	4	2	8	9	1	7	3	7	3
	Y	29		17	12	11	18	18	11	21	8	20	9
	$\chi^2(1)$	9.26											
	<i>p</i>	.002**											
Context (C)	N	23				10	13	16	11	18	5	16	7
	Y	16				3	13	7	5	10	6	11	5
	$\chi^2(1)$	0.09 ¹		1.26									
	<i>p</i>	.767		.262									
Demographics (D)	ϕ	.01											
	N	13						7	6	9	4	11	2
	Y	26						20	6	19	7	16	10
	$\chi^2(1)$	0.42 ¹		1.60		4.33							
Appearance (A)	<i>p</i>	.517		.169		.037*							
	ϕ	-.17		.26									
	N	27								19	8	19	8
	Y	12								9	3	8	4
	$\chi^2(1)$	1.57 ¹		0.09 ¹		1.22 ¹		5.77					
	<i>p</i>	.210		.765		.270		.016*					
	ϕ	.26		-.01		.24							
	<i>Attitudes/Intentions</i>												
Suspicion (S)	N	28										6	5
	Y	11										21	7
	$\chi^2(1)$	0.07 ¹		0.51 ¹		0.02 ¹		0.01 ¹		7.41			
	<i>p</i>	.794		.475		.899		.929		.006**			
Rapport (R)	ϕ	-.01		-.17		.04		.05					
	$\chi^2(1)$	0.11 ¹		0.09 ¹		1.22 ¹		0.02 ¹		0.74 ¹		5.77	
	<i>p</i>	.737		.765		.270		.884		.390		.016*	
	ϕ	-.01		-.01		-.24		-.04		-.20			

Note: Y = yes. N = no. *p* = probability value. ϕ = phi-correlation coefficient for binary variables. Column and row counts for each category are provided. Contingency tables are provided above the diagonal (the upper right part of the table). Corresponding χ^2 -tests of independence, *p*-values, ϕ -correlation coefficients are provided below the diagonal (lower left part of the table).

¹ Yates' χ^2 correction was used for all comparisons where expected cell frequencies were smaller than 5.

* *p* < .05, ** *p* < .01.

APPENDIX V.2

Categories and counts (absence/presence) of medical concerns stated by participants

Count	Frequent Concerns	Count	Infrequent Concerns	Count	Remaining Concerns
37	<i>Cardiac etiologies</i>	11	Infrequent concerns	9	Dissection
11	<i>Cardiac concerns</i>	4	Dehydration		
23	<i>MI</i>	3	GERD		
10	<i>ACS</i>	2	Esophageal Spasm		
2	<i>Unstable Angina</i>	1	Esophageal Rupture		
		1	Lyte abnormal		
		1	Pericarditis		
		1	PE		
		1	Cancer		
		1	CVA		
		10	Gastrointestinal etiologies		
		3	Upper GI		
		3	Pancreatitis		
		3	Obstruction		
		2	Gastroenteritis		
		1	Ulcer		
		1	Perforated Viscus		
		1	Cholethiasis		
		1	Mesenteric Ischemia		

Note: *Italicized items* = excluded from statistical analyses due to lack of variability. **Bolded items** = compound categories created by the experimenter. The count of compound categories corresponds to the number of participants mentioning at least one of the medical concerns included in that category.

APPENDIX V.3

Types and counts (absence/presence) of medications ordered

Medications ordered						
	ASA	Zofran	Phenergan	Nitro	Morphine	GI cocktail
Count	17	22	2	6	2	1
Anti-nausea medication			Infrequent medication orders			
24			8			

Note: ASA = Aspirin. *Italicized items* were excluded from statistical analyses due to lack of variability. **Bolded items** are compound categories created by the experimenter. The count of compound categories corresponds to the number of participants ordering at least one of the medications included in that category.

APPENDIX V.4

Categories and counts (absence/presence) of medical tests ordered

Count	Frequent orders	Count	Infrequent Orders	Count	Remaining Orders
<i>36</i>	<i>EKG</i>	15	Infrequent orders	30	Monitor
		5	Amylase	29	X-ray
		5	Old records	29	BMP
		3	Blood sugar/Accucheck	27	Sustaining patient
		2	D-Dimer	20	Oxygen
		2	Ca, Mg, Phosphate	20	Normal saline
		2	Lactate	14	Saline lock
		2	Soft tissue neck x-ray	4	IV access
		1	CT chest	1	NPO (nothing per mouth)
		1	KUB ¹¹⁸ x-ray	26	CBC
				26	Lipase
				24	Cardiac Panel (CP)
				22	Monitoring patient
				14	Pulse ox
				11	Repeat EKG
				7	Repeat TCP (90 min)
				2	Vitals
				2	Orthostatics
				17	Triage Cardiac Panel (TCP)
				17	Liver profile
				12	Urinalysis
				11	Coagulation tests
				10	CP (1 PLUS 4 orders)
				24	Cardiac Panel (CP)
				36	EKG
				29	BMP
				29	X-ray
				26	CBC
				7	Abdominal panel

Note: *Italicized items* = excluded from statistical analyses due to lack of variability. **Bolded items** = compound categories created by the experimenter. The count of compound categories corresponds to the number of participants ordering at least one of the tests included in that category.

APPENDIX V.5

ANOVA Model comparing Response Categories with respect to the MMS Subscales

ANOVA Model Response Categories	Subscales of the Mindfulness/Mindlessness Scale (MMS)											
	Engagement			Novelty producing			Novelty seeking			Flexibility		
	df	<i>F</i>	<i>p</i>	df	<i>F</i>	<i>p</i>	df	<i>F</i>	<i>p</i>	df	<i>F</i>	<i>P</i>
Stoic character (SC)				1	10.59	.003**	1	4.34	.045*	1	1.80	.190
Contextual clues (C)												
Demographic clues (D)												
Appearance clue (A)												
Cautious attitude (S)	1	5.68	.024*	1	11.48	.002**	1	3.39	.074			
Rapport (R)										1	7.72	.009**
SC x C	1	8.80	.006**							1	1.57	.220
SC x D	1	6.96	.013*									
SC x A												
SC x S												
SC x R	1	2.60	.118	1	2.80	.075						
C x D												
C x A												
C x S												
C x R	1	2.55	.121							1	1.66	.207
D x A												
D x S	1	8.91	.006**									
D x R												
A x S												
A x R												
S x R										1	5.25	.011*
Error	18			33			35			30		

Note: x = interaction between respective response categories. df = degrees of freedom. *F* = F-value. *p* = probability value.

* *p* < .05, ** *p* < .01

APPENDIX V.6

Additional and Marginally Significant Contingency Tables between Response Categories and Test Orders

<i>Response Category</i>	<i>Compound Test/Study Orders</i>					
	Monitoring patient		Urinalysis		TCP ¹¹⁹	
	Absent	Present	Absent	Present	Absent	Present
Stoic character clue	$\chi^2(1)^1 = 1.57, p = .210$					
Absent			9	1		
Present			18	11		
Contextual clues	$\chi^2(1) = 1.68, p = .195$					
Absent	12	11				
Present	5	11				
Demographic clues	$\chi^2(1)^1 = 2.60, p = .107$					
Absent	5	8				
Present	4	22				
Appearance clue	$\chi^2(1) = 3.75, p = .053^o$ $\chi^2(1)=4.45, p=.035^*$					
Absent	9	18	22	5		
Present	8	4	5	7		
Cautious attitude						
Rapport intentions	$\chi^2(1)=3.01, p=.083^o$ $\chi^2(1) = 3.75, p = .053$					
Absent			21	6	18	9
Present			6	6	4	8

Note: ¹Yates' χ^2 was used to correct for expected cell frequencies smaller than 5.

^o $p < .1$, * $p < .05$.

APPENDIX VI.1

Example Vignette with a more Ambiguous Medical Problem

It was a particularly busy shift for Dr. White. There was hardly a free bed all day and patients were boarded on the hallways because they didn't get admitted upstairs. Another squad had just called in with another chest pain patient...

Mrs. Seagull has brought in her husband Frank, who is a 55 year old men with a history of exacerbations of his liver cirrhosis. She was very upset. He was just released from the hospital a week earlier with the same problem. Without a specific diagnosis, he had been given increased doses of lactulose and sent home after a few days - only modestly improved.

Although pressed for time, Dr. White decided to sit down with the patient's wife (and her husband, but he wasn't in any shape to speak) so that she could vent if nothing else and to affirm the legitimacy of her concerns.

"Hello Mrs. Seagull?"

"Yes."

"I'm Dr. White, I heard you have been here quite a bit recently..."

"He got just released from the hospital a week ago... and now we're here again for the same issue!!"

"I know you must have told this story before but what exactly happened...?"

Frank's wife (somewhat painstakingly) started to recite their recent medical past:

"What happened is that the doctors basically brushed us off... but nobody knew what was going on, at least they didn't tell us anything..."

Dr. White nods...

"He has liver cirrhosis but he never drank alcohol in his life... He is now in advanced stages and last time they checked his ammonia level was up to 77."

"What did they do for you?"

"They gave him increased doses of lactulose while he was in the hospital."

"And what happened?"

"Nothing much... he improved modestly... but what I can't understand is that his liver is in such bad shape, he never drank a drop of alcohol in his life..."

"Hmmm... what about his ammonia level, did they find anything?"

"I don't know... but does it makes sense that a little elevation of his ammonia level causes his liver to be in such bad shape?"

"That indeed makes no real sense... what happened next?"

"The physicians here are busy... they don't even give me time to answer questions or talk about pros and cons of certain things... like the biopsy they recommended. When we finally decided to go ahead with it, they dismissed it as being unnecessary..."

"We are quite busy here, that's true... but that's no excuse. I'm sorry to hear that, Mrs. Seagull... I will try and be more available for you today!"

“ ... you know it’s not easy, I have to take care of him at home, take him to the hospital, pick him up, have to manage his medications...”

“ What’s he taking?”

“ I don’t remember most of them. He takes loads of them... but I try to make it as easy as possible on him... you know... it’s hard if you’re suffering and on top of it have to take all those strong meds...”

“ I can imagine... but what do you mean with making it easy on him?”

“ I give them according to his prescription, of course ... but when he is getting too sick, I sometimes wait with giving him all of his meds because it seems too hard on him...”

“ So you only give a few of the main medications then?”

“ Yes, until he gets better... normally, they would give him lactulose and that helped... at least he could get up and walk around.”

“ ...But not for long... from your husband’s history it looks like the symptoms came right back so you had to bring him in again...”

“ Yes, that’s right... that’s the problem... it’s only temporary help! Do you have any idea what it could be, doctor?”

“ I will see what I can do for you... we’ll run a bunch of tests... and I will think it over while they’re cooking ...”

... After an hour and a half, Dr. White came back to see the Seagulls and report on the test results.

“ I looked at several possible explanations and ran what tests I could for your husband... his blood values are ok... [??] ...nothing diagnostic of his liver problems...”

“ What about his ammonia level?”

“ His ammonia level came back elevated again – it’s 65 – so less than before...”

“ Oh, so that doesn’t help really, does it?”

“ No.”

“ So he needs lactulose again?”

“ hmmm... I was thinking about what you said regarding your husband’s meds... “

“ Yes?!”

“ You normally take your husband off most of his meds when he is not doing well, right?”

“ Yes.”

“ After taking your husband off his meds for a while, how long did you wait until you put him back on all of his meds?”

“ I normally wait until he gets better, why?”

“ Well, there may be a simple explanation to your husband’s problems... I’m not a pharmacist and I don’t know the exact metabolic pathways for all of them but my theory is that one of his medications must be metabolized by the hepatic system and thus is accumulating in his system as his liver function diminishes.”

“ So what are you saying, doctor? His meds made him sick?”

“ Well, maybe he got better not because of the lactulose taking down what really was only a minimally elevated ammonia, but because you stopped his medication while he too sick to take it... “

“ And he got worse again shortly after I restarted the medication...”

“ Exactly, and not because his ammonia was rising... that may have been only a side effect.”

” Crazy...”

” Now, I don't have any tests to prove the theory and I may well be wrong. It will take the evaluation of the pharmacist and in-house doctors to see if my theory is correct...”

“ hmmm... that's at least an explanation, makes sense though... as soon as he got better, I restarted him on his medication...”

“ I hope this hypothesis leads us somewhere... at least it got us off the same well-worn path that was leading to nowhere in this case...”

“ I really do. It's hard to take care of someone who is so sick and see no way out...”

“ I'm sure it is... your husband is in good hands here... I will tell the admitting physician that your husband may not just be - as we call it - another case of hepatic encephalopathy... they can follow up on this idea while your husband is in the hospital!”

“ That sounds promising, I'm so glad, doctor! Thank you so much!”

Approximately two weeks later, Mrs. Seagull called Dr. White in the Emergency Room to thank him for his care.

“ I'm calling to tell you that my husband is doing much better and I am, too”

“ I'm glad to hear that, Mrs. Seagull.”

“ ...your 'hunch' was quite accurate, Dr. White... the pharmacological exam showed that one of his medications was indeed exacerbating his liver problems. His meds accumulated in the liver and made his and my life a living nightmare... but that's over now... he is off that medication.”

“ Very good!”

“ He says hello and cannot thank you enough!”

“ Well, hello back.”

“ We're still wondering how you knew?”